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SANTFORD MARTIN, JR., *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

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TABLE OF CONTENTS, JANUARY 1957

Edifying Arguments 3

Jeff recalls robust rural forums.

Long-Range Outlook for Agriculture 8

E. T. York, Jr. looks at certain interesting trends.

Better Soil—Better Feed 20

W. B. Nevens and E. B. Earley give second part of important experimental report.

Soil Compaction Pattern Produced by Tillage 33

C. L. W. Swanson interprets a new era in tillage.

The Hands That Hold Higher Yielding Soil 36

A. B. Vanderford discusses six steps to high yields.

The Factories That Feed Us 46

Edwin Benne describes big job done by busy green leaves.

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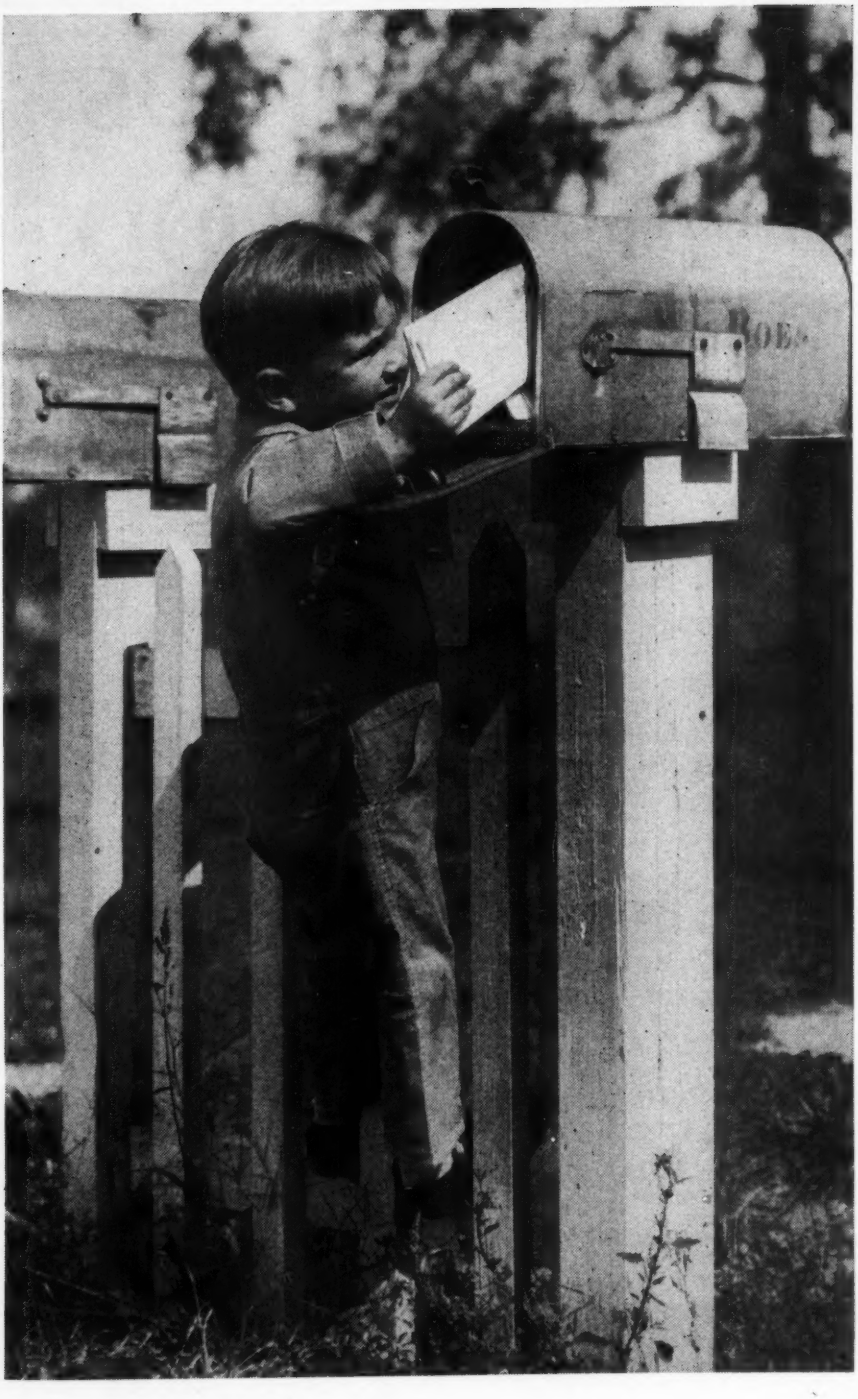

Happy Prospects — 1957

Better Crops with PLANT FOOD

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VOL. XLI WASHINGTON, D. C., JANUARY 1957 No. 1

Farm Folks Still Enjoy . . .

Edifying Arguments

Jeff McDermid

(ELWOOD R. MCINTYRE)

WE approach the season of rural gatherings, when combative speakers show that price supports, the soil bank, and production control are justified on the score of free-for-all edifying argument, if for no other reason. It was by that selfsame process that American ideals were threshed over and winnowed in the vocal days of bucolic town meetings, redolent with picturesque expressions and slam-bang invective and mixed metaphors. To be sure, back in those hearty and wordy times we had no discussion guides and county agents as chairmen or speech experts from the universities to quell the uproar and limit the verbal rounds.

Many of us who attended scores of these old-time forums do not desire to have the advance of civilization thrust a paralyzing finger of smooth conformity on such rugged spokesmen of the soil. When they insist on a strict following of Robert's Rules of Order and the Jefferson Legislative Manual, there is always grave danger that much verve and fascinating spontaneity will be quashed and silenced. That threatens to ruin some of the thrill of what was once my favorite indoor sport—reporting genuine, bona fide, dirt-farmer opinionated free speech.

As a rule, the larger regional and national farm forums run by well-established organizations are conducted on a formal pattern—more so than in the era of the Populists, the Townleyites, the original early Grangers, the Farmers' Alliance, the Agricultural Wheel, and the Brothers of Freedom. In those hectic days, rural America was making its first most determined bid for economic justice and educational opportunity. Back there in the Seventies and Eighties, the scars of sec-

tional strife had begun to heal. In their place came a new idea to debate and develop—a new union for a cherished common cause, the right of farmers to be heard and heeded.

Farmers limped over rough and stony roads blasted by the panic of 1873. There seemed to be an agonizing "surplus" of unwanted farm products, coming at a time when factory goods were high-priced in a protected, one-sided market. Surely those times called for fervid oratory to stir men to action. Georgia farmers, for instance, had owned 72 per cent of the State wealth in 1866, but only 24 per cent in 1886. A cotton planter could have paid off a thousand-dollar mortgage with 10 bales of cotton in 1870, but he had to sell 20 bales to do it in 1886. Farmers of the Midwest found wheat no longer profitable and railway rates were a punishment to producers with slim margins above meager, home-spun industry.

MEETINGS that still reflect some of that ancient ardor occur mainly in the local zones. Here cut-and-dried programs and synthetic prepared-in-advance resolutions seldom put the strait jacket on home-grown emotions.

These uninhibited gab-gatherings are distinctly an American frontier production. Their origin and circumstances were robust and provocative enough to give them a rousing start. We still have some sort of "frontier" in a social and economic sense to keep the best of them still going. Your downtrodden European peasant in days long gone had little chance to establish this kind of vocal marathon in spite of a greater impetus to hash over injustice. But our forebears had the opportunity, and the ever-ready excuse to rant and roar was not hard to cook up.

Beginnings of our rural forums were varied. Mainly, they were camp meetings and caucuses. One had religious fervor and emotional pitch and the other was a fearless and robust form of political science. It was the village church and the town meeting that drilled the public-speaking spirit into the bosoms of the pioneers in our cradle communities.

As settlers moved westward this independent, outspoken tendency went along with the Conestoga wagon and the trail-side campfire, and roosted snugly in the rafters of crude cabins, ready to fly to the aid of him who stood in need of succor or reform.

It was through the lyceum and debating society and the hard-plank protracted revival meetings that the virility of farm forums was nurtured and strengthened. These earnest church sessions were called "protracted" for no idle reason. They were usually continuous and lengthy affairs, because sins and remorse were common inflictions and the healing and consoling elders and ministers were not numerous and had long and difficult journeys to make between waiting and eager congregations.

I have handy the autobiographies of Rev. Peter Cartwright and Rev. Alfred Brunson. They had a system of their own to perpetuate the testimonials and keep alive the spirit of communion. These two ministers rewarded their followers who had oratorical talent by naming them deacons and church wardens, with power to keep the altar fires blazing all along the circuit. Some of their disciples were men of power while a few relied on "pow-wow-er" which fitted them like their deerskin garments to be convincing sin-chasers.

NEXT to the speech-stimulating influence of the pioneer church and camp meeting, we cannot overlook the elementary and heart-warming influence exerted in this direction by the country storekeeper. Here was the best practice ground for talented but untried vocal prowess. Here it acquired courage and skill enough to get up and testify in church or debate public questions. The cluttered back cor-

ner of the general store was the birthplace of that best beloved of our American spellbinders—the cracker-barrel philosophers.

They had to temper their natural coarseness, too, because in such a public spot many farm women and children clustered around the potbellied stove to warm both limbs and intellect. Quite often this spontaneous speechifying amid the prunes, paint pots, and plowshares brought forth new leaders and held rural attention and respect. The country emporium remains a source of envy and imitation, which few modern food stores or department salesrooms can hope to equal. Who can pause to hear a spellbinder when turnstiles and package-checkers impede, and where is the brave philosopher who can find a vantage point for his delivery in places devoid of armchairs, spittoons, and cast-iron heaters?

There remain but few of these welcome old places as new streamlining methods come to the rural zones. Maybe we should encourage merchants to cling to outmoded features and fixtures, if for no other reason than to preserve this ancient proving-ground for vigorous vocabularies and freedom of opinion. To leave all this to the bright, young Future Farmers and 4-H clubs may seem wiser to the majority, yet these worthy enterprises often smack too much of scholastic and regimented procedures.

It seems hard sometimes for them to awaken our vocal vim to the old boiling point, which campfires, revivals, and lyceums so thoroughly engendered. Maybe we don't get mad enough that way, anymore, to have our say-so. Maybe we expect the more educated and well-trained to do it for us.

In these days it would be hard for the extension agent to conjure up the fancy fixings that went along with the discussions and traditions of the frontier. I refer to a Paul Bunyan, a Captain Kidd, or a Bigfoot Wallace, able to lend his romance to stimulate raw and unprocessed philosophy about laws, government, and social conditions.

Today we are conscious always of precedent, of conforming, of being just like other youth, of discussing only material gadgets and demonstrating purely technical methods. We drown out imagination and primitive insight, lest it be regarded as "irrelevant and immaterial" before the bar of public opinion.

Alongside of this standardization, we have succeeded in cutting down the frequent use of strong, simple, and forceful Anglo-Saxon words and idioms. These were the ready helps that our forebears used to hew out a wilderness, elect their officers, serve on grand juries, and win wars. I do not wonder at the reluctance of amateurs to be outspoken in public nowadays, as the terms are too sophisticated and imported from foreign tongues under a costly tariff of misunderstanding and futility.

When I began making the winter rounds as a farm reporter we had country institutes, farm-week short courses, and conventions held by cooperative creameries and the locals of large propaganda outfits. Thus there was a good range of opportunity for local talent to

be vocal under varied incentives.

We had such subjects to tackle as new skill and knowledge, the economics and risks of the farming business, and the general propaganda in behalf of the farming profession facing a competitive world of industry and high finance. It was on the threshold of the new day in agriculture, and many of us were slow to see its coming and resisted its inexorable advance with flaming tongues.

QUITE naturally, they often got all mixed up in a scrambled dish of opinions. The loudest of the leather-lunged delegates had been forced into long silence during a season afield. So down they came to all and sundry of these different meetings to uncork pent-up theories and frothing grievances which even the toughest chairman found hard to resist.

So we had politics and economics injected at what were regarded as purely educational courses, much to the dismay of the conservative Dean and his faculty. We also had lots of religion and toplofty philosophy smuggled into the "United Farmers" conventions, and livestock freight rate and commission charges hauled to view at creamery meetings. Each and every chance to unburden the mind was accepted as germane. Yet all this, however, irrelevant, resulted in more basic education in the long run.

They had scapegoats to lead to the shambles, also. Chief among these in those days in my bailiwick were the State Agricultural College and the Federal Department of Agriculture, as well as laws and regulations that stepped on the toes of the agrarian community.

Those stout old debaters and floor-hoggers sweated harder at forensic forays in those turbulent times than they did at threshing bees. Serious, witty, original in expression, crude and caustic, they removed the hides, skillfully rubbed in the salt, and stretched the skins on rigid frames to make a tanning job par excellence.

My only wonder, as I sharpened my pencil to keep up with their sharper language, was why in thunder they so often scalped and flayed their erstwhile friends and farm associates, and let a whole woodpile full of worse varmints escape their guns and booby traps. Many of them lived to see their errors in tactics. Like the gent in the story, "They shot the wrong dog and let the sheepkiller get away."

Realization of the value of rural appeal by our major radio and TV stations, and the efficiency of our state-owned broadcasting systems, threatens to diminish the attendance at these rallying points of bucolic debate. But even then many of the programs on the air do not give the stay-at-homers the actual blow-by-blow doings. Quite often they choose rather dull and dismal spots to broadcast, such as the remarks by the Dean and the welcome address by the mayor in greeting the grangers.

TO miss some of the impromptu diatribes handed out at the mid-winter forays is to lose half of the joy of being present. We reporters were seated up in front at a rickety old pine table just under the rostrum edge. It was close enough to hear all the phrases before they used microphones. We were kept well humidified by stray drops from the water pitcher and the sweat wiped vigorously from oratorical brows. We all craved the reporter's chance to quote the best of the spasmodic gems of simon-pure native eloquence, usually not as strong on grammar as it was on gestures and gusto.

I recall one doughty farmer of foreign birth who occupied a place on the "United Farmers" legislative committee. He was always hawk-shawing around to peg a popular issue to advance or a doubtful law to defeat. Finally one year he centered his flow of rhetoric against the gathering and pub-

lishing of agricultural statistics. He was sure it led to a reduction of farm prices, for some vague reason, but he was not so sure how to pronounce the awful word. "My committee is vorking to get the state to do away mit dem damn farm statics!" Today those same "statics" are as much of a fixture as the w. k. *status quo* itself. Mayhap it was made stronger by just such argumentative opposition.

I am glad that the agricultural colleges and some farm societies put out instructions on holding meetings and giving rules of good discussion. Sometimes these circulars outline both sides or all three sides of the argument. Too often they impose the terrific job as chairman upon the overworked county agent.

At such assemblies it is not regarded as good form to let the thing go "natural" and run itself. It is not soundly applauded for any geezer with wildflower ideas of his own gathering up at the headwaters of the creek to clamber on the podium and divest himself of suspicious inuendoes or bold and brazen irrelevances contrary to the ultimate in conservatism. He would be ushered pronto into the doghouse reserved for dissenters and malcontents.

I WONDER how far the old elders would have gotten had they been circumscribed and limited in their preachments of a lurid sort of salvation or damnation. Just because we think we are sober and refuse to see snakes and scorpions crawling over the scenery, it might be smart to take a little dose of radical medicine anyhow.

There were certain kinds of farm meetings I liked to avoid if possible, or else take a seat away back in the rear somewhere. This was the old-style farmers' institute. They invited anybody in the community to tote in specimens of fowl maladies and alimentary disorders of the pig. Being unfamiliar with Latin or Greek nomenclature and with a terrific aversion to loose bacteria from any insidious source needlessly exposed, I kept my rearward seat as far to the windward as possible. For here was one good example of how well the research veterinarian and the able extension agent earned their money. With sleeves rolled to the elbows, and with gestures as deft as Blackstone, the magician, these zealous workers in behalf of a healthy and unsullied animal kingdom diagnosed as long as the nose could stand it.

IT was a great boon to mankind and reporters in particular when some college gent invented and used the lantern slide system of exhibiting in colors all about animals far gone with everything. More folks could then see it all from where they sat and not have to come closer to inspect the carcass.

It is good to realize that the farmers' meetings are not by any means extinct or out of date. If the time ever came when farmers just sat at home in what leisure hours they possess to get all their information from the library and the air waves, we might get stagnant and in-grown as far as new ideas and better programs go. It still holds true that public gatherings that are run well and have a high priority topic at hand form a sound educational system for adults. Argument brings out intelligent appraisal, for or against.

My hope is that as farm youth get schooled in the proper technique of holding meetings they will not fold up their native imagination and stifle their originality and firm convictions. For by and large, the only big group of allied original thinkers we have left are those who live and work beyond the city suburbs—assuming they do not get drunk on too much "canned" propaganda brands.

To such persons we can entrust the delicate job of keeping alive the spark of speechmaking that we listen to because we want to, not just to be polite.

◄◄◄

As we pause to consider certain trends . . .

Long-Range Outlook for Agriculture . . . GOOD!

What other business can virtually be assured of an additional customer every ten to twelve seconds, night and day?

By E. T. York, Jr. • **Washington, D. C.**

THE failure of agriculture to share in the prosperity enjoyed by most other segments of the national economy in recent years has caused a growing concern over the "farm situation." Declining farm incomes have prevented many industries which serve the farmer from enjoying comparable rates of expansion with sister industries. A pessimistic outlook for agriculture has even been reflected in the numbers of students enrolling in agricultural curricula in the nation's colleges and universities. Since 1950 in most of the Land Grant Colleges, the percentage of students studying agriculture has declined sharply, and agricultural leaders are becoming increasingly concerned over the situation.

The current pessimism among farm-

ers as well as many businesses dependent upon farm prosperity suggests the need for an appraisal of our present situation and a look at certain trends which may suggest possible future developments in agriculture. The limitations of long-range projections are, of course, recognized. However, an analysis of past trends and of present circumstances may help to provide a basis for making reasonably good guesses about future developments. These projections are based on a continuing healthy economy without any major depressions or wars.

Most of the data cited herein have been taken from numerous government publications. Likewise, most of the projections have been made by government economists. We have attempted to collect and synthesize these scattered bits of information and consider the possible implications of these projections upon the agricultural economy, giving particular emphasis to possible demands for fertilizers.

Present Situation

Many factors have undoubtedly contributed to the present farm situation. It is generally agreed, however, that the low farm prices and declining farm income have been due primarily to overproduction during the past several years of many agricultural commodities which have accumulated through Commodity Credit Corporation Loan programs. The Soil Bank program was passed by Congress this year with the objective of boosting, or at least maintaining, farm income at current levels while farm production was reduced. This legislation was enacted too late in the season to provide a basis in 1956 to judge its potential effectiveness. However, we might examine the current situation and see what the Soil Bank program hopes to accomplish in 1957.

Since 1910 the amount of land in the United States planted to harvested crops has ranged between 300,000,000 and 360,000,000 acres. During the past few years, approximately 330,000,000 to 340,000,000 acres have been planted to harvested crops. Latest U. S. D. A. estimates suggest that 40,000,000 to 45,000,000 of these acres will be placed in the Soil Bank program in 1957. This would mean a reduction in crop plantings of some 12% to 14%. No one expects this to result in a proportionate reduction in production. However, unless there is an unusually good growing season in 1957, it seems reasonable that with expected participation in this program, over-all production should be reduced by at least 5%, and perhaps more with some crops.

In 1955 farm output exceeded utilization by only 3%. It is obvious, therefore, that only a very small decline in production as a result of the Soil Bank program can prevent further build-up or even facilitate a reduction in surplus stocks.

At the present, Commodity Credit Corporation's stocks of wheat and cotton exceed one year's production and feed grain stocks equal about ⅓ of a single year's output. However, only about ½ of the present corn and wheat stocks and ⅔ of the cotton stocks would normally be considered "surplus" since some carry-over is essential. Some progress has been made this year in reducing this surplus through accelerated domestic and export disposal programs. Figures just released indicate that for the first time in six years cotton consumption in 1956 exceeded production and the surplus was reduced by some 2½ million bales or approximately 16%. On the other hand, the unusually good season has contributed to higher corn production and stocks of corn will undoubtedly increase.

Looking ahead to 1957, the U. S. Department of Agriculture is encouraged over the prospects of a sizable reduction in wheat production next year through increased participation in the Soil Bank. A reasonably large cotton acreage is expected to go into the Soil Bank, and all-out attempts will be made to induce a large participation by

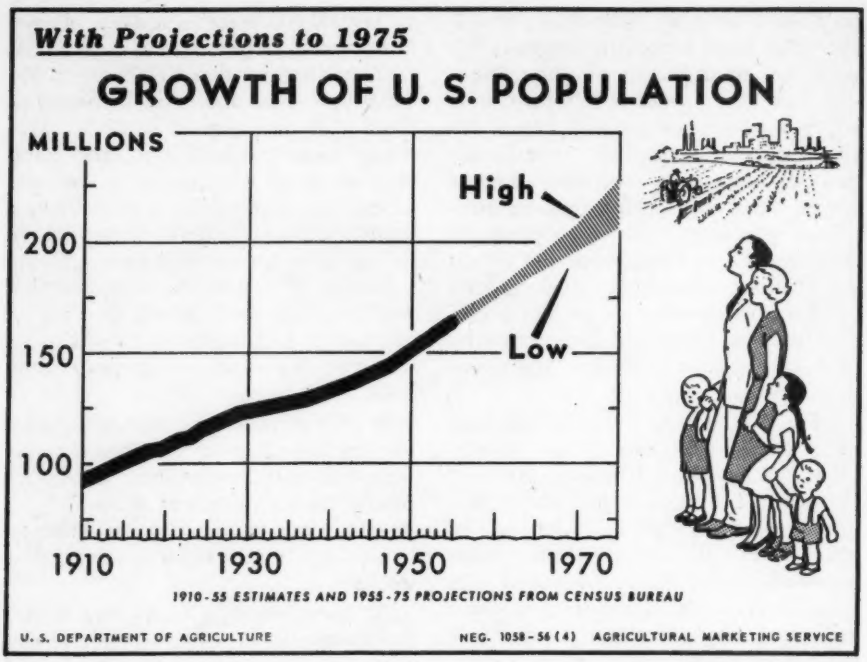

Fig. 1 **Population Changes**

corn growers. A 20% reduction in flue-cured tobacco acreage has already been announced for 1957 which should result in production levels below current rates of utilization.

The four-year downward trend in farm income has apparently been halted with an increase of approximately 4% in net farm income reported for 1956. The U. S. Department of Agriculture indicates that present prospects are for some further increase in 1957. Payments under the Soil Bank program have been an important contributing factor to this year's increase as they undoubtedly will be next year.

The demands for farm products in the years to come will depend primarily upon growth in population and consumer income—with population changes having by far the greatest influence.

The population of the United States in mid-1955 was estimated at more than 165,000,000 people, some 30% more than in 1935. A recent projection by the Census Bureau foresees a population of approximately 220,000,000 in the United States by 1975 (Figure 1). This would be an increase of almost 35% above the 1955 level. Some analysts have suggested an even faster increase in population during the next 20 years, pointing out that the number of women in age groups 20-34 years in 1975 may be 45% above the level in 1955.

Government economists predict that the size of the nation's economy by 1975 may be twice that of the base year 1953 (Figure 2). Growth of the economy will depend upon expansion in demand and on potential output as determined by employment, hours worked, and output per man hour. Recent trends in productivity and prospective growth of the labor force indicate that a doubling in gross national product in the next 20-25 years is highly possible for an expanding peacetime economy.

Such an increase in the output of the economy with the associated gains in employment would lead to an increase

in per capita income of around 60% between 1953 and 1975; the anticipated increase for 1960 is 10-15%. An increase in income of this magnitude would expand the demand for all goods and services including food, clothing, tobacco, and other commodities made from farm products.

Figure 3, showing past trends in farm output and projected needs during the next two decades, indicates the need for an increase of more than 40% in farm output between 1951-53 and 1975. These projections are based on a population increase of about 1/3 and an increase in average per capita consumption of about 1/10 from 1951-53 to 1975.

Population changes alone during the next two decades may add 30-35% to the total demand for farm products. The effect of increasing incomes upon the demand for farm products is less direct. In fact, consumption of farm products as a whole is not very responsive to changes in either prices or income. The projected rise of about 60% in real income per person will probably result in a very small increase in total per capita use of food and other farm products. Perhaps of greater significance is the fact that increasing incomes will likely modify the pattern of consumption and change the nature of the farm products desired.

Figure 4 shows the trend in our eating habits over the past 45 years with projections to the next 20 years. During this period, consumption of potatoes and cereal grains has been less and less. On the other hand, there has been a marked rise in consumption of meat and animal products, fruit, and vegetables. These trends are expected to continue. Figures 5 and 6 indicate potential production needs for crops and livestock in 1975 as compared with 1953. These figures indicate an approximate 45% increase in demand for all livestock and livestock products and a 25% increase in demand for harvested crops. A marked increase in demand

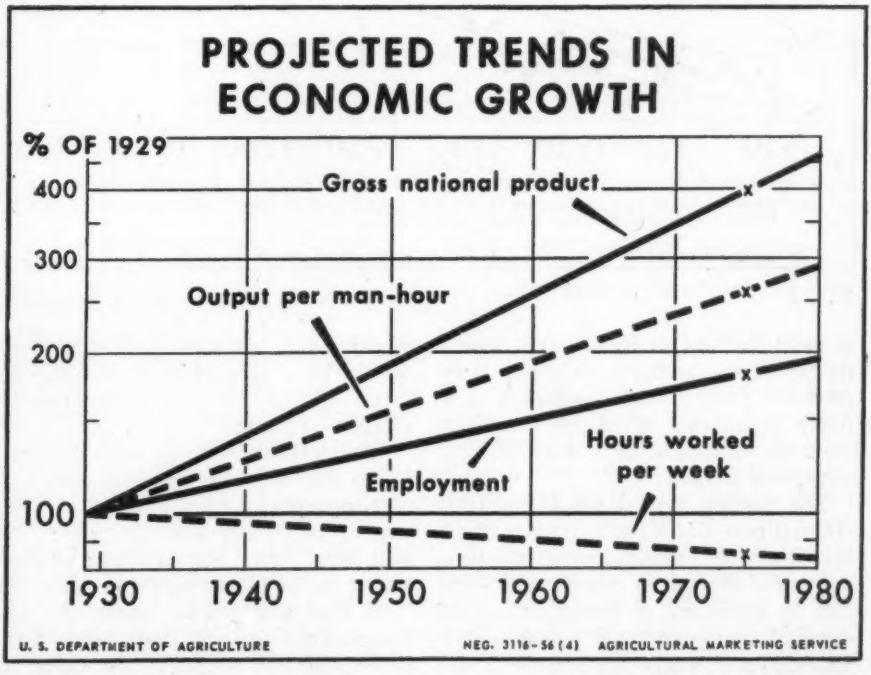

Fig. 2 Economic Growth

for forage crops is also anticipated.

World populations are expected to increase around 40-45% from 1950-1975, with larger than average gains in India and in countries of the Far East, Latin America and the Middle East. Increases somewhat smaller than average are in prospect in Western Europe, Oceania, Japan, and Africa. The Food and Agriculture Organization of the United Nations suggests a world demand for food in 1975 some 50-65% above 1950. As in the United States, the per capita demands for meat, dairy products, fruit, and vegetables are likely to increase much more rapidly than the demands for cereals, starchy roots, and sugar.

The foreign market for U. S. agricultural products depends upon a number of complex factors, many of which are non-economic in nature and difficult to appraise. Nevertheless, world demand for agricultural products will increase and world markets will undoubtedly continue to take considerable quantities of our production of cotton, grains, tobacco, fats, and oils.

Agricultural exports for the United States in 1952-53 were less than 1/10 of the total output. The volume of agricultural exports projected for 1975 is about 17% above the figure for 1952-53. Thus, with the trend towards self-sufficiency in most foreign countries, export markets may not increase as rapidly as the demands of domestic markets. However, with increasing world needs for food products, there should be a small but continuing increase in the volume of agricultural products exported.

With a continued expansion in population and consumer income, projected requirements for farm products in 1960 may be approximately 12% above the base year 1953. Since current production rates of most crops are above the 1953 level and surplus stocks of some commodities are still quite large, little or no increased output would appear to be needed to meet projected require-

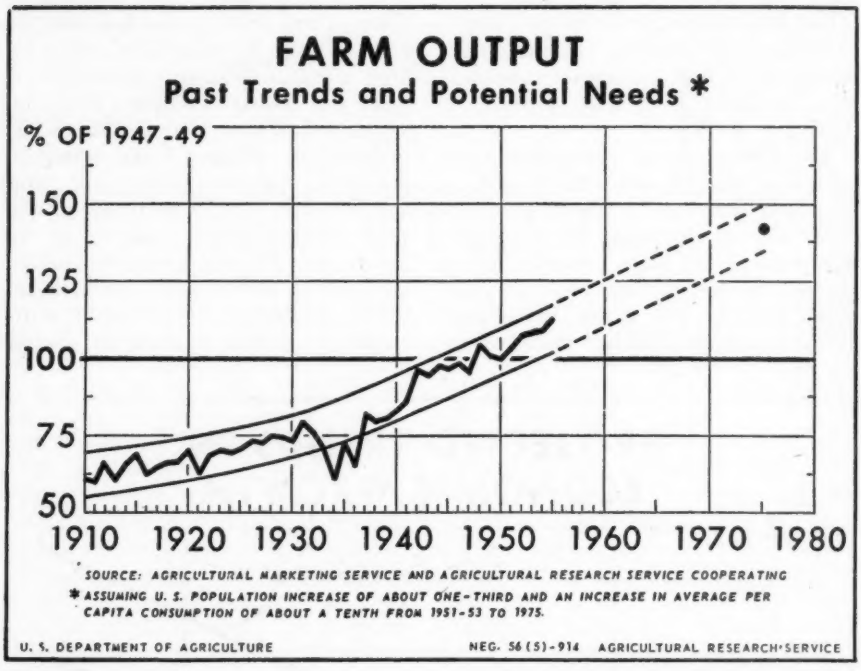

Fig. 3 **Farm Output—Past Potential**

ments by 1960. It would appear that requirements for agricultural products in 1975 will be about ⅓ higher than current levels of production.

If projected production requirements were met solely through increases in area of cropland, an additional 150,000,000 acres would be needed by 1975. However, if present trends in land usage continue, this increase in production may be realized without an increase in total acreage farmed. A reptful if the development of these areas will more than offset the land diverted to other uses. It is estimated that during the past 15 years, approximately 17,000,000 acres of productive farm land has been put into non-agricultural use —for roads, houses, industry sites, etc. With an expanding economy, this diversion of farm lands will likely continue, perhaps at an accelerated rate.

Figure 7 shows the annual changes in farm output during various periods

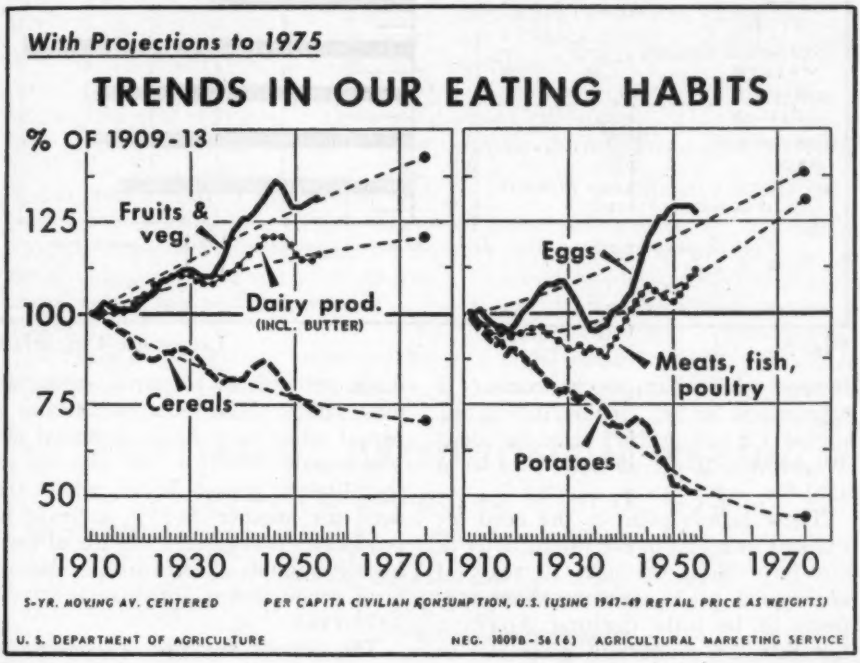

Fig. 4 **Eating Habits—Some Trends**

resentative of the U. S. Department of Agriculture recently said: "For 400 years, we have been able to take care of the increase in population by moving West and opening up new lands. This is no longer possible. Most of the additional production must come from 'building-up' present areas." In other words, agricultural frontiers today are in technology and research rather than in geographical exploration.

Although some new lands can be brought into production through clearing, drainage, and irrigation, it is doubtfrom 1910 to 1953 along with projections to 1975. It will be noted that changes in the source of farm power or mechanization have contributed greatly to increased output up until the present. However, with a high percentage of farmers now using tractor power, mechanization is expected to contribute little to needed output in the future. Increased output must be realized to a large extent, therefore, from factors other than mechanization (increased yields per acre, etc.). In fact, increased farm output due to higher yields, and

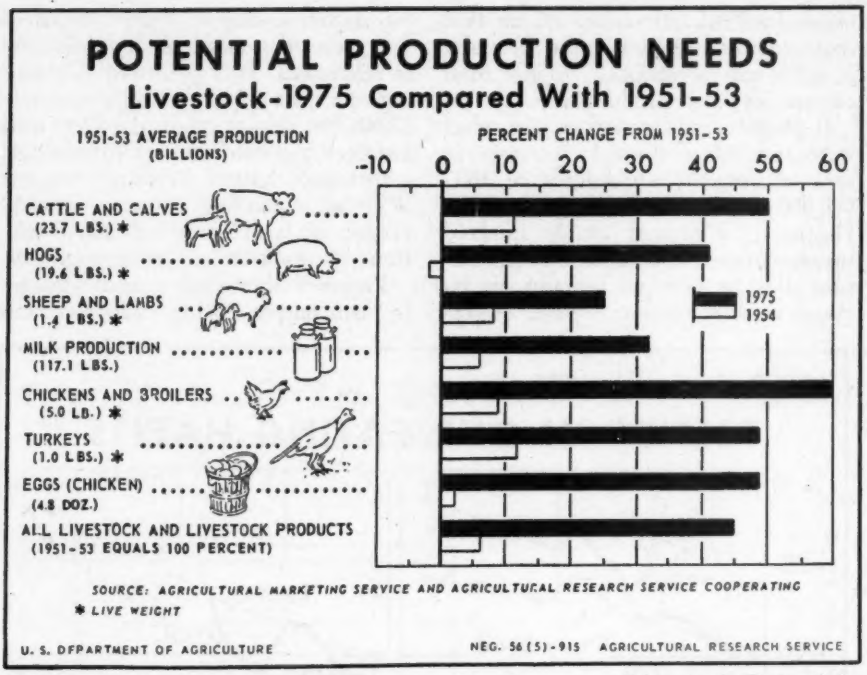
POTENTIAL PRODUCTION NEEDS
Livestock-1975 Compared With 1951-53
1951-53 AVERAGE PRODUCTION (BILLIONS)
PERCENT CHANGE FROM 1951-53
-10 0 10 20 30 40 50 60
CATTLE AND CALVES (23.7 LBS.) *
HOGS (19.6 LBS.) *
SHEEP AND LAMBS (1.4 LBS.) *
MILK PRODUCTION (117.1 LBS.)
CHICKENS AND BROILERS (5.0 LB.) *
TURKEYS (1.0 LBS.) *
EGGS (CHICKEN) (4.8 DOZ.)
ALL LIVESTOCK AND LIVESTOCK PRODUCTS (1951-53 EQUALS 100 PERCENT)
1975
1954
SOURCE: AGRICULTURAL MARKETING SERVICE AND AGRICULTURAL RESEARCH SERVICE COOPERATING
* LIVE WEIGHT
U. S. DEPARTMENT OF AGRICULTURE
NEG. 56(5)-915 AGRICULTURAL RESEARCH SERVICE

Fig. 5 **Livestock Potentials**

factors other than mechanization is expected to be 50% higher during the period 1951-53 to 1975 than the post-World War II period from 1944-46 to 1951-53.

These factors point to the need for marked increases in the productivity of our farm lands the next 20 years, if anticipated needs are met. There appears to be little question, however, but that the production goals can be met through the development and application of improved technology. In fact, much of this increased production could undoubtedly be realized through the use of technology already available to the American farmer.

The anticipated need for greater agricultural production will undoubtedly mean increased demands for fertilizers. In fact, fertilizer usage per unit of output may be expected to become greater and greater as efforts are made to increase acre productivity.

Figure 8 shows the trend in fertilizer usage per unit of farm output since 1935. During this period, fertilizer usage per unit of output increased almost 200%. This occurred during a period when acre yields increased approximately 30-35%. In looking at the 20-year period ahead when the need for another 30-35% increase in production is suggested, the use of even higher amounts of fertilizer per unit of farm production is anticipated.

1957-1960

The outlook for any *substantial* increase in fertilizer consumption during the next 3-4 years is not good. Production levels of many farm commodities will have to be lowered to allow the disposition of surplus stocks and facilitate a better balance between supply and demand.

The Soil Bank program designed to reduce production of these stocks may afford opportunities to maintain at least current levels of fertilizer utilization. The National Plant Food Institute suggests that the net effect of the Soil Bank in 1957 could be at least a 0.5% increase in fertilizer consumption. Assistant Secretary of Agriculture Butz

recently suggested that the Soil Bank program might increase fertilizer consumption as much as 1.5-2%.

In some areas, the Soil Bank will undoubtedly result in less fertilizer usage. A sizable participation in the program by cotton growers in the Southeast would adversely affect the fertilizer market there. A 20% cut in flue-cured tobacco acreage (irrespective of the Soil Bank) will certainly reduce fertilizer usage with that crop in 1957.

It is encouraging to note that fertilizer consumption (on a plant food basis) has continued to increase slowly during the past 4-5 years even in the face of declining farm income. With favorable developments in the Soil Bank plan and with accelerated disposition of surplus farm commodities (greater exports, etc.), we may see a continuing small increase in fertilizer usage during the next four years.

1960-1975

Assuming the present agricultural program meets with reasonable success, the excessive reserves of most farm products should be depleted and farm production and utilization should be in reasonable balance by 1960. In fact, if the farm program does nothing more than hold production to current levels, the expected increase in demand for farm products by 1960 could essentially take care of the surplus problem. Then with an expanding population and economy, we should expect a continuing increased demand for fertilizers as production goals are increased. The rate of this increase is, of course, highly speculative.

Several factors suggest that the increase in plant-food usage may be greater during the period 1960-1975 than during the last 15-year period:

(1) The production of agricultural commodities is expected to increase by about the same percentage during the 1960-75 period as during the last 15 years if anticipated needs are met. The total increase in production, however,

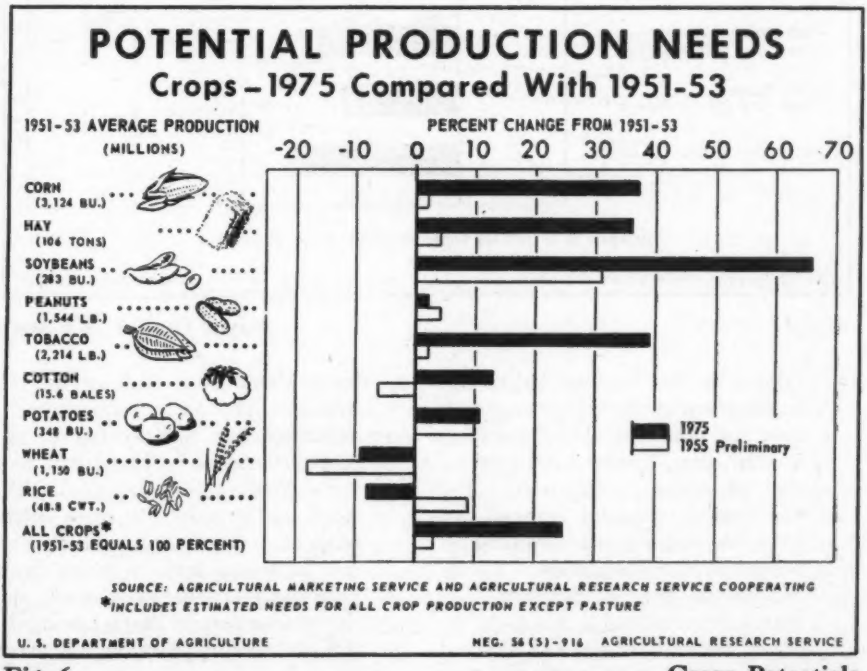
POTENTIAL PRODUCTION NEEDS
Crops – 1975 Compared With 1951-53
1951-53 AVERAGE PRODUCTION (MILLIONS)
PERCENT CHANGE FROM 1951-53
-20 -10 0 10 20 30 40 50 60 70
CORN (3,124 BU.)
HAY (106 TONS)
SOYBEANS (283 BU.)
PEANUTS (1,544 LB.)
TOBACCO (2,214 LB.)
COTTON (15.6 BALES)
POTATOES (348 BU.)
WHEAT (1,150 BU.)
RICE (48.8 CWT.)
ALL CROPS* (1951-53 EQUALS 100 PERCENT)
1975
1955 Preliminary
SOURCE: AGRICULTURAL MARKETING SERVICE AND AGRICULTURAL RESEARCH SERVICE COOPERATING
*INCLUDES ESTIMATED NEEDS FOR ALL CROP PRODUCTION EXCEPT PASTURE
U. S. DEPARTMENT OF AGRICULTURE
NEG. 56(5)-916 AGRICULTURAL RESEARCH SERVICE

Fig. 6 **Crops Potentials**

would be considerably greater. This would be done on essentially the same acreage, requiring greater in-puts of fertilizer for each crop unit produced.

(2) Changes in eating habits toward more livestock and livestock products should require greater total production and increased fertilizer usage. Animals are relatively poor converters of energy, requiring approximately 5-10 calories of energy in the form of grain to produce one calorie in the form of meat. By substituting meat for grain, potatoes, and other high-starch foods in human diets, greater total production of crops is required. The anticipated increased demand for livestock also suggests tremendous potentials for fertilizers. L. B. Nelson of the Agricultural Research Service of U. S. D. A. recently said, "Pastures and hayland represent the most neglected segments of our agriculture from the standpoint of lime and fertilizer usage," and he foresaw enormous opportunities for increased fertilizer usage with these crops.

(3) Another factor in favor of a more prosperous agriculture and greater demand for fertilizer in the next 20 years as compared to the last two decades is the rapid decline in farm work-stock. Since 1935, the number of horses and mules on American farms has been reduced from about 16½ million to 4½ million. This trend toward mechanization has released some 38,000,000 acres of cropland that had been growing feed for this work-stock, to be used for some other purpose. It is obvious that had this land not been diverted from growing feed for work-stock, the the production of farm commodities in recent years would have been less than requirements (as-

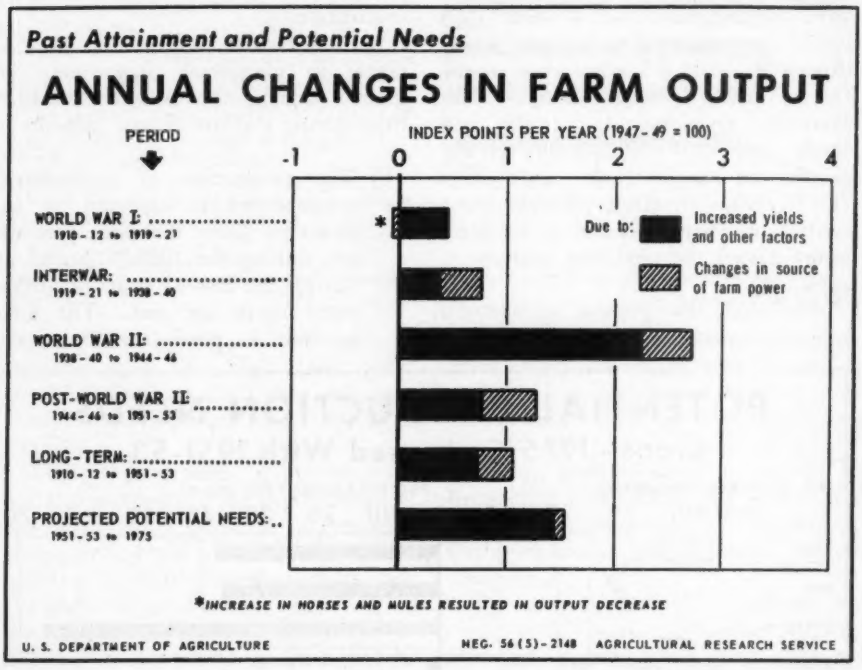
Past Attainment and Potential Needs
ANNUAL CHANGES IN FARM OUTPUT
PERIOD
INDEX POINTS PER YEAR (1947-49 = 100)
-1
0
1
2
3
4
WORLD WAR I: 1910-12 to 1919-21
INTERWAR: 1919-21 to 1938-40
WORLD WAR II: 1938-40 to 1944-46
POST-WORLD WAR II: 1944-46 to 1951-53
LONG-TERM: 1910-12 to 1951-53
PROJECTED POTENTIAL NEEDS: 1951-53 to 1975
Due to:
Increased yields and other factors
Changes in source of farm power
*INCREASE IN HORSES AND MULES RESULTED IN OUTPUT DECREASE
U. S. DEPARTMENT OF AGRICULTURE
NEG. 56(5)-2148 AGRICULTURAL RESEARCH SERVICE

Fig. 7 **Farm Output—Changes**

suming yield levels and other factors had remained the same). It is conceivable, therefore, that we might never have experienced this period of surplus and decline in farm prices had there not been this diversion of land from work-stock feed production. This is significant in that once adjustments have been made in production to conform with present needs, there will not be this problem of "absorbing" the production from such large acreages of land in the future since the reduction in work-stock numbers will be relatively insignificant in the years to come.

(4) Earlier this year the President appointed a special commission to study possibilities of developing and expanding industrial and other non-agricultural uses for farm products. Congress is expected to be called upon to increase greatly appropriations for research on this problem. Significant developments in this field along with accelerated efforts to expand our export markets could mean increased demands for agricultural products far in excess of those projections based upon domestic population gains and expansion in the economy. Any such increased demand for agricultural products would, of course, have a favorable influence upon the fertilizer market.

Some potentialities for fertilizer use were pointed out recently by C. M. Ferguson, Administrator of the Federal Extension Service:

"Although farming in the United States has made phenomenal progress, we are yet a long way from applying our current stock of scientific knowledge. For example: Although use of fertilizer has increased steadily, many farmers still have their crops on a semi-starvation plant-food diet. For the country as a whole, farmers are using

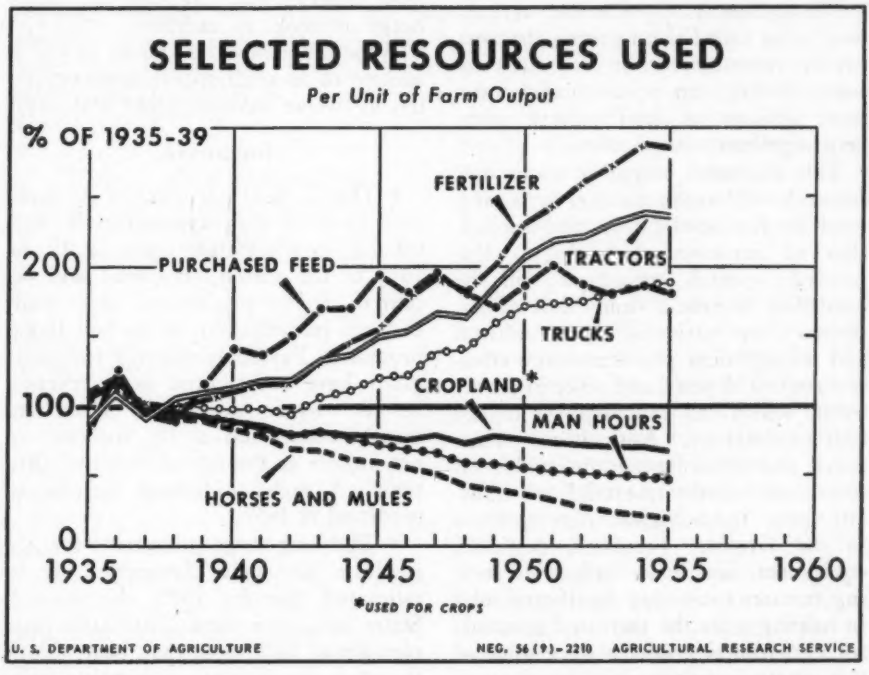

Fig. 8 **Resources Used**

less than half as much fertilizer as the experiment stations and extension agronomists and soil specialists say they could use profitably."

Ferguson refers to fertilization levels which would be profitable under present conditions. Profitable levels of fertilization would undoubtedly be higher under the conditions expected during the next two decades.

Increased Need for Trained Personnel

The prospects of American agriculture being called upon during the next twenty years to increase its output by some 30-40% on approximately the same amount of land present some very significant implications.

This increased output of crops and livestock will mean an ever-increasing need for the development and application of improved technology. Expanded research programs will be needed to provide a steady flow of improved crop varieties, better cultural and management practices, more effective control of pests, and other improvements which can contribute to higher unit productivity. Agricultural educational and service programs will need to expand in order to extend and translate new technological developments to the farmer. Fertilizer, pesticide, equipment, and other industries serving farmers must play significant roles in helping meet the increased demands for agricultural products since some of the greatest opportunities for increasing unit productivity lie in the use of the products of these industries.

Expanded activity in all phases of agriculture and associated industries during the next twenty years will require increased numbers of technically trained personnel. We are already falling far short of meeting the present-day needs. Recent surveys indicated that, even now, there are at least two jobs available for each college graduate in agriculture. Graduate programs are currently not even supplying present needs for scientists and teachers, to say nothing of anticipated requirements. Furthermore, as farming becomes more and more complex, there will be an ever-increasing need for more technically trained farm operators and managers.

Certainly, the opportunities for technically trained personnel in agriculture during the next several decades should be equal to those in other industries. Although agriculture, like any other industry, will undoubtedly be faced with "ups and downs" and periods of adjustment such as the one we are now experiencing, the over-all, long-range outlook is excellent.

What other business can be virtually assured of an additional customer every ten to twelve seconds, night and day?

Summary

• The U. S. Department of Agriculture predicts that approximately 40,000,000 to 45,000,000 acres or 12 to 14% of the nation's cropland will be retired from production this year through participation in the Soil Bank program. Payments through this program have contributed to a reversal in the 4-year downward trend in farm income, and a 4% increase in net income to the farmer reported this year. A slight additional increase is predicted in 1957.

• The long-range projections for agriculture are quite favorable. It is estimated that by 1975, the United States may have some 220,000,000 people—about 35% more than now. Furthermore, government economists foresee a doubling of the nation's economy by 1975 with an increase in per capita income of some 60%.

• This expansion in population and over-all economy is expected to increase demands for agricultural products to more than 40% above the 1951-1953 levels. In view of the current overproduction and accumulation of surplus commodities, little need for increased production of farm products is anticipated by 1960. An estimated 30-35% increase above the current levels is anticipated by 1975. ◄◄◄

SOYBEANS RESPOND IN CAROLINA • SOYBEAN NEWS DECEMBER, 1956

Several studies have been conducted in North Carolina over the past 15 years on the use of fertilizers and lime for soybeans. In nine experiments on coastal plain soils of North Carolina it was found that the application of lime and 40 pounds of P_2O_5 and 80 pounds of K_2O per acre gave an average increase of 12.4 bushels of soybeans (Table 1). Their studies showed that in each instance when lime, phosphate and potash were added, the maximum yields were obtained.

Table 1. Yield Response from Lime and Fertilizer on Soybeans

Average yield for 9 fields

	Bushels Per Acre	Gain In Yield
With no treatment...	22	....
400 lbs. 0-10-20.....	27.2	5.2
1 ton of lime.....	24.8	2.8
Lime plus 200 lbs. 0-20-10.....	27.0	5.0
Lime plus 160 lbs. 0-0-50.....	29.7	7.7
Lime plus 400 lbs. 0-10-20.....	34.4	12.4

They found that while the amount of calcium in the soil was important, additions of calcium sulfate were ineffectual compared with equivalent amounts added as lime. This was on soils with a pH around 5. The acid soil apparently prevents the nitrogen fixing bacteria from doing their work and the addition of lime corrects this condition and also supplies enough calcium for the soybean crop. On soils containing less than 80 pounds of P_2O_5 per acre the response to applications of 20 to 60 pounds of P_2O_5 was generally more than 5 bushels per acre, on soils of more than 80 pounds of P_2O_5 the response generally less than 5 bushels.

Likewise additions of 60 to 100 pounds of K_2O on soils containing less than 0.15 m.e. of K per 100 grams of soil the response to potash was more than 5 bushels per acre, while on soils containing less than 0.15 m.e. of K the response was generally less than 5 bushels.

A breakdown of the individual soil factors analyzed indicated that phosphorus is the most important soil factor in the production of soybeans and the pH of the soil is next. In other words, the soil phosphorus level of the soil accounts for the largest amount of the variation in yield and that the soil pH accounts for the next largest variation in yield.

Experiments both in the field and greenhouse indicated that the phosphorus status of the soil was the best measurement for predicting the yield of soybeans. A large part of the variation in the yield of soybeans as related to the chemical properties of the soil could be accounted for by the level of soil phosphorus.

A fairly good correlation existed between the soil phosphorus content as measured by the weak acid extraction method and the per cent increase of yield with phosphorus fertilization. The theoretical soil phosphorus level at which no further response to phosphorus would be expected was found to be in the high category of the soil test measurement.

The data for potassium indicate that for the soils of the coastal plain the amount of soil potassium present generally was the important factor in determining whether or not a response would be obtained and not the per cent of potassium saturation. ◄◄◄

BETTER SOIL—BETTER FEED

Part II—Adequate Fertilization Improves Feeding Value of Forages and Sometimes Grains

By W. B. Nevens[1] and E. B. Earley[2]

SUITABLY fertilized grass pastures and meadows produce forage which is higher in protein and occasionally also higher in phosphorus than forage grown on poor soils. Do legume forages and grains respond in like manner?

Fertilization Needed for Legumes

Few of the good forage legumes grow to advantage on impoverished soils. Soybeans may produce a fair crop on poor, acid soil but respond quickly to soil treatment.

Establishment of legumes and improvement in the botanical composition of the herbage, that is, growth of more desirable species, are the great reward of a liming and fertilization program. Pasture and meadow forage consisting in part or wholly of such legumes as alfalfa, alsike clover, ladino clover, crimson clover, red clover, and sweet clover nearly always is higher in protein content than forage consisting only of grasses. Furthermore, soil treatment thickens forage stands and tends to crowd out weeds. Often the high weed content of pasture and meadow forage grown on poor soils keeps the feeding value low. Also, a number of different kinds of weeds cause objectionable flavors in milk.

The protein content of legume forage seldom is increased through nitrogen fertilization of the soil. Legume seedlings require available nitrogen in order to get started but once they have become established the nodules on their roots enable them to make use of the nitrogen of the air and thus free them from complete dependence on soil nitrogen.

In an Illinois experiment heavy applications of phosphorus were more effective than light ones in raising the phosphorus content of legume hay (Table I) (7). On the other hand, trials at Cornell University in which ladino clover was fertilized with four levels of lime and four levels of phosphorus failed to show increases in calcium, phosphorus, or protein content of the crop even though yields were increased (9). In Michigan experiments the phosphorus content of soybeans, oats, and alfalfa was increased significantly as the amount of phosphorus added to the soil was increased (6). In the same series of experiments phosphorus treatments caused a rise in the percentage of protein in soybeans but caused a fall in the protein content of oats.

Fertilization Improves Grains

It is commonly assumed that the fertilization of grain crops increases yields but brings no increase in feeding value per pound. This assumption may have had its origin in the observed failure of soil treatment to enhance the content of protein, phosphorus, or other nutrients when fertilization was carried out on land already well supplied with plant

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food or when the amount of fertilizer applied was inadequate. Furthermore, below-normal rainfall may not have permitted full development and yield of the crop. In a study of the effects of weather conditions, Stubblefield and DeTurk noted that a crop grown on the same plot in succeeding years may vary as much in chemical composition as when grown under different soil treatments (10).

Hamilton and associates found that the soil treatments and crop rotations in use on the Morrow Plots at the University of Illinois were responsible for significant increases in kernel weight and protein and phosphorus content of corn grain (2). These plots have been under essentially the same management (fertilization and rotations) since 1876. The figures in Table II are for the 70th crop grown on the plots.

The protein contents of corn and oats grown on the Morrow Plots in a different year are shown in Table III (8). The protein content of oats was increased by fertilization and also by the use of clover in the rotation but the increase was not as marked as in the case of corn.

Soil treatment with phosphate fertilizer may or may not effect an increase in the feeding value of corn grain, depending largely upon the character of the soil and the amount of available plant food already present. Fertilization trials with corn on a light-colored, phosphorus-low soil showed that phosphorus additions brought no increase in phosphorus content of the grain (Table IV). However, the addition of limestone to the soil caused a release of organic nitrogen by the soil organisms and gave an increase in yield and protein content of corn grain. The inclusion of potassium in the fertilizer treatment had no effect on the potassium content of the grain but almost doubled the yield of corn per acre.

Fig. 1. Corn from plots heavily fertilized with nitrogen not only yielded more but the grain was higher in protein content than the crop from unfertilized plots (Illinois tests).

TABLE I.—YIELD AND PHOSPHORUS CONTENT OF RED CLOVER HAY IMPROVED BY SOIL TREATMENT

Kind	Fertilizer used		Hay yield per acre	Phosphorus in hay
	Amount per acre	Phosphorus per acre		
	lb.	*lb.*	*lb.*	*lb./ton*
None	0	0	5,480	2.8
Superphosphate	250	22	7,220	3.4
Fused phosphate	250	34	9,380	3.8
Rock phosphate	1,000	140	9,360	4.4

Snider, H. J. Better Crops With Plant Food, 29, April 1945.

TABLE II.—EFFECT OF CROP ROTATION AND SOIL TREATMENT ON YIELD AND COMPOSITION OF CORN GRAIN, MORROW PLOTS, UNIVERSITY OF ILLINOIS

Plot	Crop rotation and treatment	Yield per acre	Av. dry wt. of 100 kernels	Protein in dry matter	Phosphorus in dry matter
		bu.	*grams*	%	%
3NE	Continuous corn..... No treatment	30.3	22.9	7.5	0.23
3NW	Continuous corn..... No treatment	16.0	22.3	7.1	0.24
3SE	Continuous corn..... L, M, bP	87.7	27.7	8.6	0.27
3SW	Continuous corn..... L, M, rP	81.6	27.8	8.5	0.27
5NE	Corn, oats, red clover..... No treatment	83.1	27.2	9.6	0.21
5NW	Corn, oats, red clover..... No treatment	68.5	24.8	9.7	0.20
5SE	Corn, oats, red clover..... L, M, bP	123.3	31.4	10.3	0.28
5SW	Corn, oats, red clover..... L, M, rP	119.3	29.6	10.4	0.30

L = limestone; M = manure; bP = bone phosphate; rP = rock phosphate. Hamilton, T. S., et al. Cereal Chem. 28:163-176. 1951.

Phosphorus treatment of a highly productive, dark soil had no effect either on the protein content or on the phosphorus content of corn grain (Table V). But when nitrogen was also included in the treatments the percentage of protein in the grain was stepped up by as much as one third. A heavy rate of application of nitrogen (160 lbs. of nitrogen per acre) brought higher yields and higher protein percentages than the lower rate (80 lbs.) and was fully as effective as the very heavy rate (320 lbs.).

TABLE III.—YIELD AND PROTEIN CONTENT OF CORN AND OATS FROM THE MORROW PLOTS.

Soil treatment	Corn		Oats	
	Grain per acre	Protein content	Grain per acre	Protein content
	bu.	%	*bu.*	%
Corn-oats rotation				
None.....	22	7.8	30	12.1
M, L, rP.....	83	10.2	54	13.9
Corn-oats-clover rotation				
None.....	46	9.4	53	13.4
M, L, rP.....	101	11.4	72	14.7

M = manure; L = limestone; rP = rock phosphate
Snider, H. J. Ill. Agr. Exp. Sta., Bul. 539.

Trace Elements Needed

In some cases the yields of crops may be limited and the nutritive value of the forage may be below par because of insufficient amounts of certain trace elements in the soil. This term refers to the elements present in very small amounts, or traces. Sandy soils and also light-colored soils which have been depleted by heavy cropping over a long period without replenishment of plant food often may be benefited by applications of fertilizer to which have been added small amounts of the elements needed.

Dr. A. J. Ohlrogge of Purdue Uni-

Fig. 2. In one series of experiments corn forage from fertilized fields had a higher protein content than the forage from unfertilized fields.

versity recently formulated trace element recommendations based upon the reports of agronomists of a seven-state area, including Minnesota, Iowa, Wisconsin, Michigan, Illinois, Indiana, and Ohio (4). Attention is called to the requirements of particular kinds of plants for boron, manganese, iron, copper, zinc, calcium, magnesium, and sulphur. For example, too small an amount of boron in an alfalfa soil is likely to cause yellowed tops and stunted plants.

R. L. Fox of the Nebraska Station reports that sulfur shortage can hurt alfalfa (1). The second-year yields from three cuttings were: from untreated soil, 1,500 lbs.; from plots treated with phosphate, potash, and lime, 3,400 lbs.; and from plots treated with phosphate, potash, lime, and 100 lbs. of agricultural sulfur, 6,600 lbs. The protein contents for the third cuttings were 15.2%, 17.6%, and 21.1%, respectively. The carotene content (provitamin A) from the fertilized plots was considerably higher than from the untreated.

In some cases the amount of a trace element taken up by the plant from the soil or from foliar applications on the leaves is extremely difficult to measure chemically. On the other hand, animal responses from the feeding of forage grown on soils treated with trace elements or from feeding minute

Fig. 3. Contrary to popular opinion, the protein content of corn grain is likely to be increased when the soil is treated with adequate amounts of fertilizer, including large amounts of nitrogen.

amounts of a particular element involved may be rapid and dramatic. One of the best examples of this is the response of cattle and sheep suffering from a cobalt-copper deficiency. In Australia applications of as little as one-fourth pound of crude cobalt salts to the acre of pasture corrected severe nutritional disturbances in sheep. Areas where cobalt deficiency has been noted have been reported in seven states in this country and also in western Canada.

Selenium poisoning, commonly known as "alkali disease" or "blind staggers," has been reported in seven of the Great Plains and Rocky Mountain States. Where the selenium content of the soil is high, both the forage and the grains may contain toxic levels of this element. Animals restricted to feeds grown on selenium-high soils develop lameness, the hoofs may slough off, appetite declines, and the animals may die of starvation. Human cases also have been reported.

Molybdenum poisoning, known also as"teartness," is another illustration of a relationship between the content of the element in the soil and the amount in the plant. Just as in the case of selenium poisoning, plants grown on soils, having larger than normal amounts of molybdenum take up enough of the element to cause excessive diarrhea and loss of weight and production, particularly in cows and calves. The trouble was first observed in England and later in a few areas in this country.

Vitamin Content Increased by Fertilization

Vitamin A, which dairy cattle obtain chiefly from the carotene of forages, is essential for health. When the only carotene source is ripe or bleached pasture grasses or hays low in green color, cattle may suffer from various forms of malnutrition.

On most soils fertilization is necessary for the establishment and growing of good legume pastures and meadows. The Maine Experiment Station in studying 14 different forage species found that legumes were much higher in carotene content than were the grasses (5). An exception was in fresh lawn clippings.

The National Research Council in its recommended nutrient allowances for dairy cattle gives the estimated carotene

Fig. 4. On poor soils the use of fertilizers may double or triple yields and also bring increases in the percentages of protein and phosphorus. Right, fertilized; left, unfertilized.

content of quickly cured, bright green hay as 35 to 40 milligrams per lb.; legume hays with good green color and leafy, 18 to 27 milligrams; while badly bleached or discolored legume hays with traces of green color have 4 to 8 milligrams per lb. (3). These carotene values are based upon the work of Guilbert of the California Station.

Fertilization of grasses prolongs the period of rapid (green) growth and thus aids in the production of forage higher in carotene than that obtained from unfertilized grasses. Higher carotene values in legume forage grown on fertilized soil may possibly be accounted for by greater leafiness since leaves usually are much higher than stems in carotene content.

Thus soil treatment indirectly contributes to an increased vitamin content. Present information does not provide adequate proof of a direct effect of soil fertilization upon vitamin content.

Summary and Recommendation

Soil fertilization is not likely to improve the protein content of legume forages but in several experiments it did increase the phosphorus level. In the case of corn grain, soil fertilization alone (at sufficiently heavy rates of application), or soil fertilization combined with the use of crop rotations which included legumes, increased both the protein and the phosphorus contents. The application of trace elements to soils deficient in those elements improved the nutritive value of forages and corrected nutritional disorders in livestock. Some trace elements, when present in the soil in unusually large amounts, may be taken up by plants in quantities sufficiently great to be injurious to stock. The vitamin value of forages may be indirectly increased through fertilization of the soil.

As soils continue to be cropped, more

TABLE IV.—EFFECT OF SOIL TREATMENT ON YIELD AND COMPOSITION OF CORN GRAIN (POOR SOIL)

Soil treatment	Kind of corn	Yield per acre	Composition of grain		
			Protein	P	K
		bu.	%	%	%
None	H. Moore	14.4	8.25	0.21	0.68
	U. S. 200	14.8	9.12	0.27	0.59
	U. S. 448	17.8	9.00	0.27	0.62
R	H. Moore	23.5	9.00	0.24	0.72
	U. S. 200	21.9	9.62	0.25	0.62
	U. S. 448	23.5	10.38	0.25	0.59
RL	H. Moore	46.3	10.38	0.28	0.59
	U. S. 200	43.6	11.50	0.29	0.78
	U. S. 448	43.9	13.00	0.29	0.72
RLP	H. Moore	48.9	11.44	0.31	0.68
	U. S. 200	44.0	11.44	0.28	0.68
	U. S. 448	41.6	12.12	0.32	0.68
RLPK	H. Moore	72.3	11.12	0.24	0.65
	U. S. 200	81.6	11.62	0.27	0.72
	U. S. 448	77.3	12.75	0.26	0.60

P = phosphorus; K = potassium; R = residues; L = limestone.
Unpublished data from A. L. Lang and H. J. Snider; Enfield (Ill.) Soil Experiment Field.

and more attention must be given to the plant-food supply. High nutritive value of the crops as well as high yields to the acre are dependent upon soils having an adequate supply of plant nutrients.

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TABLE V.—EFFECT OF SOIL TREATMENT WITH NITROGEN AND PHOSPHORUS ON YIELD AND COMPOSITION OF CORN GRAIN (PRODUCTIVE SOIL).

Factors studied	Phosphate applied lbs./A [1]	Nitrogen applied lbs./A [2]			
		0	80	160	320
Yield, bu./A [3]	0	58	92	118	95
Protein, % [4]		7.4	9.6	10.1	9.9
Phosphorus, % [4]		0.26	0.24	0.25	0.24
Yield, bu./A	20	53	90	101	92
Protein, %		7.5	9.5	10.1	10.0
Phosphorus, %		0.27	0.23	0.24	0.22
Yield, bu./A	80	60	102	106	96
Protein, %		7.4	9.4	10.5	10.1
Phosphorus, %		0.28	0.26	0.25	0.24
Yield, bu./A	160	52	98	112	107
Protein, %		7.1	9.0	10.3	10.0
Phosphorus, %		0.28	0.26	0.29	0.27
Yield, bu./A	400	67	115	120	122
Protein, %		7.5	9.5	10.4	10.7
Phosphorus, %		0.29	0.31	0.30	0.29

[1] Phosphoric acid (P_2O_5) applied as 0-20-0 plowed under.
[2] Applied as ammonium nitrate plowed under.
[3] No. 2 corn containing 15.5% moisture.
[4] Dry basis.
From corn research by E. B. Earley. ◄◄◄

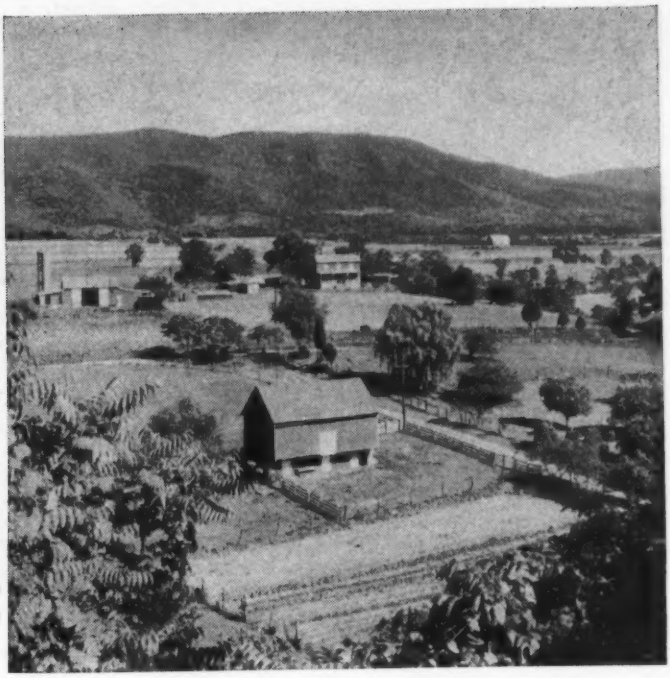
"Farming isn't just men and land and animals and machines. It's one of the most exciting laboratories in the world today. It holds promise of vastly greater material benefits to man than he has ever known since the beginning of time." —*Ezra Taft Benson, Secretary of Agriculture.*

PICTORIAL

Toward better crops . . .

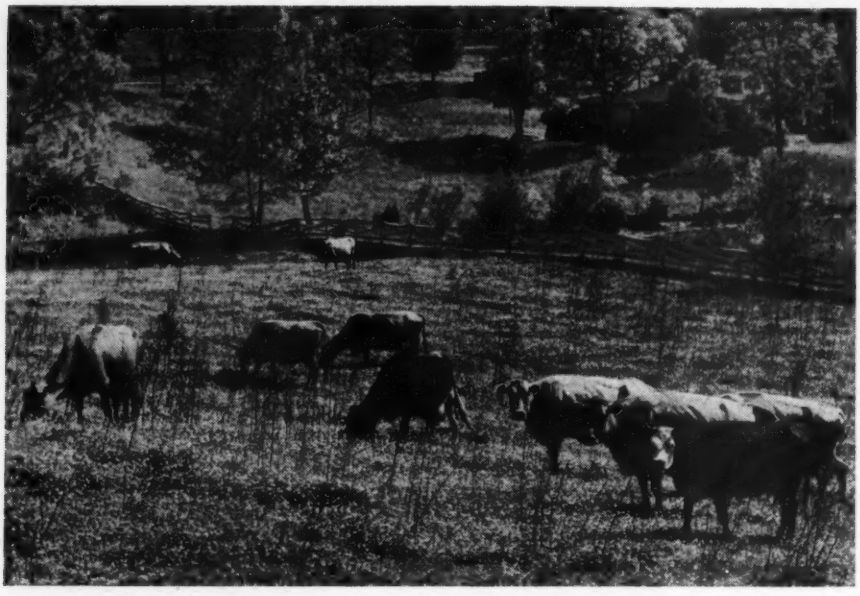
. . . on the plains

. . . in the mountains

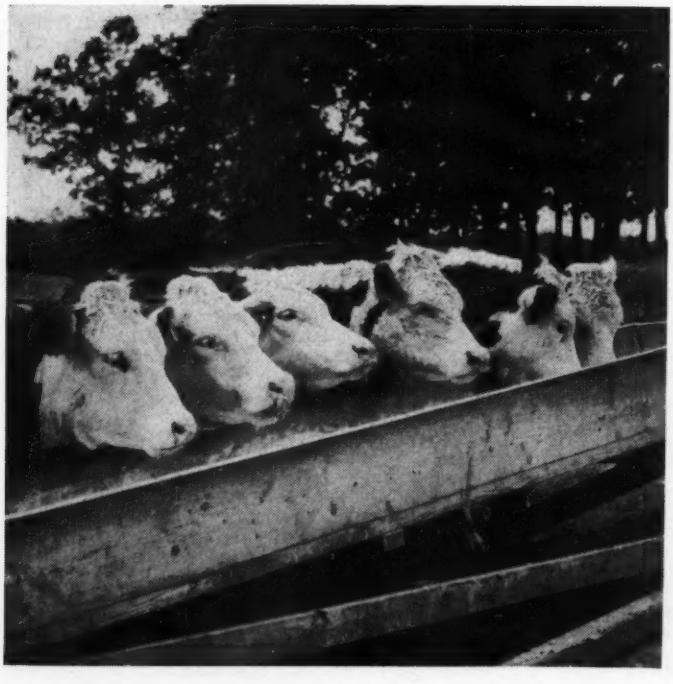


in the valleys . . .

on the slopes . . .



. . . in the meadows



. . . on the feedbox

The Editors Talk

Our Cover Picture

Typical of its appearance on many broad-leaf plants, potash deficiency on canna in later stages shows up as a browning or necrosis on the edge of the leaf. This is seen on the leaf in the insert in our cover illustration this month. Also shown on the cover is the tremendous growth of well-planted cannas.

A genus of tropical summer-flowering plants of the Banana Family, cannas grow from thick, fleshy tuber-like roots. They attain a height of from 2½ to 10 ft. in the tropics and sub-tropics where they grow wild. In the more northern regions where they are used as annuals they seldom exceed 5 or 6 feet in height.

It is stated that few plants are more easily grown than canna. However, to support such tremendous growth, the soil must be rich, deep, and moist. This means it must contain ample supplies of the necessary plant foods, particularly potash. When it is considered that cannas develop tubers from which they are propagated and that all tubers—such as potatoes, dahlias, etc.—are greedy feeders on potash, this requirement is easily understood.

For Three Decades

Just over 31 years ago, in September, 1925, a quiet, soft-spoken young man off a Wisconsin dairy farm walked up the steps of No. 10 Bridge Street in New York City to sit in the editor's chair of *Better Crops,* the pocket book of agriculture, published in that day by the Potash Importing Corporation of America.

Last month, December, 1956, R. H. Stinchfield retired as editor of *Better Crops with Plant Food,* still the pocket book of agriculture, now published by the American Potash Institute of Washington, D. C., composed of five major potash producers of America: American Potash & Chemical Corporation, Duval Sulphur & Potash Company, Potash Company of America, Southwest Potash Corporation, and United States Potash Company Division of United States Borax & Chemical Corporation.

R. H. STINCHFIELD

The name of R. H. Stinchfield is well known to agricultural America. Here we look in on him editing his last copy for *Better Crops,* the journal he edited for over 31 years. Since 1935, Mr. Stinchfield has headed all publications issued by the American Potash Institute, which was formed in that year.

And in those three decades, R. H. Stinchfield did far more than edit just another agricultural journal. He helped develop a brand of scientific journalism in agriculture.

When he came to work on *Better Crops,* the magazine was barely a year old. And the only space for the editor's desk at that time was in a small corner of Mrs. Catherine Schmidt's potash library. Out of that corner, he started building a journal that has served American agriculture usefully and loyally for over three decades.

Born on a dairy farm near Waupaca, R. H. Stinchfield had to drop out of high school briefly at 18 because of polio—but soon returned to go on to the University of Wisconsin, where he interrupted his education, again, to help his mother after his father died.

Following World War I service at the Great Lakes Navy Center, he returned to graduate from the 4-year agriculture course at the University of Wisconsin. For a brief time, he handled the press services of the Wisconsin College of Agriculture, wrote a farm column for the *Milwaukee Journal,* and did considerable writing for the *Breeder's Gazette.*

In October, 1927, he married Miss Helen Lewis of South Milwaukee. They met at the University of Wisconsin. They have two daughters—Mrs. Nancy T. Mertz of Washington; and Sandra, now a student at Penn Hall.

He is a member of the University Club of Washington, D. C., Alpha Zeta, Sigma Delta Chi, and Alpha Gamma Rho. He has a green thumb in the yard and a keen eye for antiques —which he plans to work fully after a trip South with Mrs. Stinchfield.

At 5 o'clock on his last day at his desk, he was editing copy for *Better Crops.* He started as a working editor and he retired as a working editor.

He worked hard to keep *Better Crops* honest, accurate, interesting—to fulfill its slogan: "The Whole Truth—Not Selected Truth."

And he succeeded—for 31 years.

No fuller tribute could be written of Editor Ros Stinchfield.

Meet Our New Editor

SANTFORD MARTIN, JR.

Santford Martin, Jr. comes to us direct from a 4-year position as Publications Editor for the North Carolina State College Development Program. Prior to that, he was Director of Information for the N. C. Hospitals Board of Control.

Winston-Salem native, he received his B.A. and M.A. degrees from Wake Forest College in 1947 and 1948 after 3 years military service. He majored in journalism-English and from 1948 to 1951 was Publicity Director and Department Head at Gardner-Webb College. He wrote news releases, Sunday features for state papers, magazine articles, and radio scripts. He is a member of Kappa Sigma.

Mr. Martin was married in 1948 to Miss Mary Fran Harrell of Marshville. They have two children: Miriam, 3 years; Santford Frank, 11 mos.

With the Institute, Mr. Martin will serve as editor and Director of Publicity. He will welcome suggestions from our readers for better information and cooperation in programs of soil and crop management.

H. B. Mann, *President*

Soil Compaction Pattern Produced by Tillage

By C. L. W. Swanson

Soils Department • Connecticut Agricultural Experiment Station

RUNNING over the land by tractors and implements in plowing, discing, harrowing, and cultivating for row crops during a growing season can be bad for our soils. This is especially true if done excessively.

Thousands of penetrometer measurements made on soils under cultivation in Connecticut show that tractor and implement traffic produces at least three distinct and varying degrees of compact layers or zones in soils:

(a) Discing, harrowing, and other seedbed and cultivation treatments after plowing compact the soil at a 3- or 4-inch depth to form a secondary tillage sole;
(b) In plowing, the rear tractor wheel running in the furrow packs the furrow bottom, making a compact plow sole; and
(c) Tractor wheels in row cultivation compress the surface 3 or 4 inches of soil, retarding root growth and water intake in the wheel-compacted area.

These compaction layers are shown diagrammatically in Fig. 1.

Seedbed and cultivation treatments after plowing loosen the upper 3 to 4 inches of the plow layer. In this secondary tillage zone the soils are loose, friable, and well aerated.

In the secondary tillage sole below, the soil has been compacted by seedbed preparation; it has been relatively undisturbed after plowing except for compaction. This may be thought of as residual structure contrasted to that produced in the layer above. Tillage tends not only to compact soils but also to arrange the soil particles in closest packing, resulting in fewer large pores.

In plowing, the rear tractor wheel runs in the furrow, packing the furrow bottom. Compressive action of the plowshare may also pack the soils. Penetrometer measurements show the plow sole to be about 50 to 75% harder than the subsoil below.

One way of breaking up the plow sole is with deep-rooted legumes. In clover plots, for example, percolation was 62% better than in continuous corn.

The plow sole may also be broken up mechanically with a subsoiling apparatus. Research on this is in progress.

The diagram shows the effect of tractor wheels in packing soils in row crops after three cultivations. Here the secondary tillage zone is compressed and eliminated by the tractor wheel. Penetration of corn roots was restricted somewhat by this compact layer, but was not of enough consequence to reduce corn yields measurably.

With the advent of the tractor, it is a rather easy matter to till our soils. Because of this, tractors and cultivation equipment have been blamed for the poor structure of many of our soils. It isn't the implement that is at fault; it is how this implement is used in soil management.

In some experimental plots at this Station, soils with good tilth (struc-

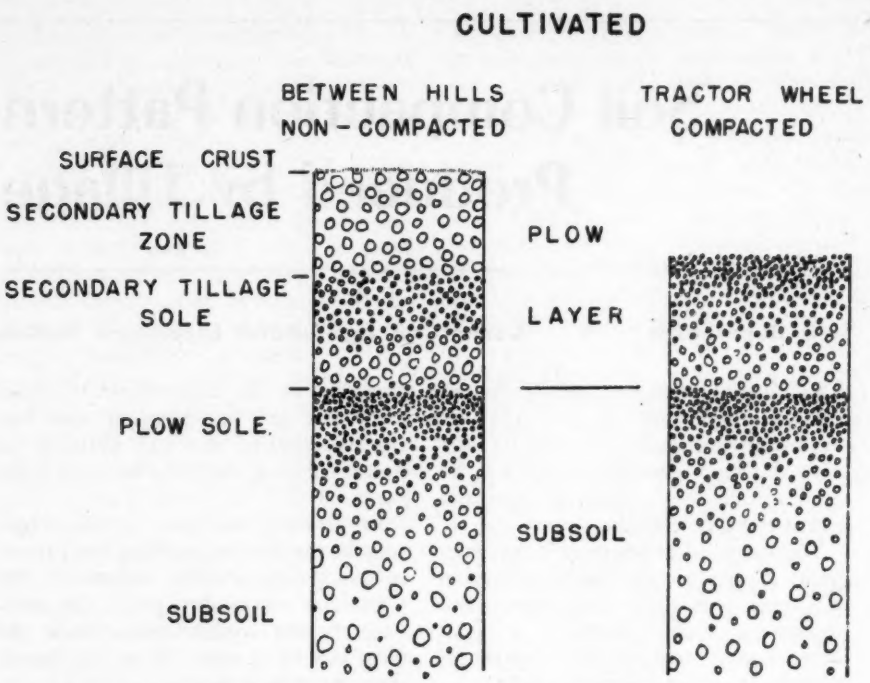


Fig. 1. Many measurements made on Connecticut soils under cultivation show distinct compaction layers. Plow sole in tractor-wheel compacted soils may be about 50 to 75% harder than the underlying subsoil. This plow sole may be broken mechanically with a subsoiler or penetrated with legume roots increasing percolation of soil moisture.

ture) yielded as a 6-year average 103 bushels per acre compared with 84 for soils in poor tilth. The high-yielding soils had an average of 13% lower bulk density, required 116% less force to penetrate the soil 3⅜ inches, had 60% greater non-capillary porosity, and had 11% more organic matter. The plots were all fertilized with 5-10-10 equivalent to 1,800 pounds per acre annually.

This research shows that for highest yields, cultivation should be reduced to the minimum. But before minimum cultivation can be practiced, the soils must be kept high in organic matter and in good structure so that surface crusting and compaction will be minimized.

We are entering a new era on thinking relative to tillage and crop growing—till the soil at a minimum, reduce compaction, and fertilize heavily. All this means new machines.

◄◄◄

TO GROW AS VIGOROUS STANDS . . . AS POSSIBLE

PLANT disease specialists at the University of Wisconsin found that root rots are caused by many different kinds of fungus organisms present in Wisconsin soils. And the best way to fight these rot-producing fungi, they say, is to grow as vigorous stands of red clover as possible.

That's where the lime and fertilizer come in. Lime, if needed, and fertilizer will help red clover fields build good food reserves so they will grow strong and healthy. They can then fight off an attack of the fungus.

Best way to tell how much fertilizer and lime is needed is by a soil test.

PLANTS, LIKE PEOPLE, MUST HAVE ROOM TO LIVE

PLANTS, like people, must have room to live. Low yields may sometimes suggest a predicament akin to that of the short boy in the large family. He had a good start and was of good stock, but he had to grow up under the table. His limiting factor was head room. With plants it may be root room.

More living room for roots is the most effective way, in many soils, to step up plant growth. On Merrimac sandy loam in the Connecticut Valley, shattering the compaction pan, or hardpan layer below plow depth, makes possible a deeper and more extensive root system on crop plants.

Detailed studies of the relationship between soil conditions and root growth are under way at the Tobacco Laboratory of The Connecticut Agricultural Experiment Station at Windsor. Henry C. deRoo of the Department of Soils finds that "physical soil condition now seems to be an obstacle in many soils where drainage, irrigation, better varieties, adequate fertilization, and pest control are the rule." The mechanized farmer, he points out, seems to be tilling the surface and packing the plow-depth layer, thereby creating a soil zone too hard for roots to enter.

Deep tillage cracks this hardpan layer, makes more water storage space available, and opens new reserves of plant food at lower levels. More living room is available to roots, and they use it. Soil-conditioning crops, mostly grasses and legumes, fit into the rotation designed to hold and better this more open soil structure. The fewer trips made over the field by tractors and other heavy machines, the less this traffic will pack the surface soil and recreate the hardpan layer below the tillage level.

Dr. deRoo shows how he takes a careful look at roots. With needles spaced 2 inches apart on a 20- by 40-inch panel, he takes a 6-inch slab of soil from the side of a pit adjoining a growing plant. The needles hold the roots in place while the soil is soaked and carefully washed away in a tank filled with water. A photograph pictures the root distribution pattern for convenience in comparing root growth under different tillage and cultural methods.

CORNERSTONES . . . OF OUR VITALITY AND ECONOMY

"One of the major problems today is to get research results translated into action. The time lag between the discovery, or the development, of research results and their application on the farms of the Nation has been, and is, too great. We must all work harder on this phase of the research-education pattern. We need a better system of two-way communication between research and farmers."—*Ezra Taft Benson, Secretary of Agriculture.*

"The production of food and fiber is the most essential—the most basic—of all economic activities. Much of our strength as a Nation has been built on the foundation of a productive agriculture. Economic progress has been sparked by the initiative and enterprise of free individuals. Vast improvements in living standards have taken place on our farms, in our towns, and in the cities. A stable, prosperous, and free agriculture is truly the cornerstone of our national economy and the Nation's vitality."—*True D. Morse, Under Secretary of Agriculture.*

The Hands That Hold Higher Yielding Soil Are Those That

- Use the land wisely
- Prepare the land fully
- Use fertilizer and lime
- Irrigate when necessary
- Use the best varieties
- Control insects & disease pests

BY A. B. VANDERFORD • DEPARTMENT OF AGRONOMY • MISSISSIPPI STATE COLLEGE

FARMERS of the South for several years now have been limited in the number of acres they could plant to certain basic crops. The reduction in acres that could be planted to various cash crops caused farmers to select the best land available for these crops. This was the first big step in producing high yields per unit of land.

By starting with soils well suited for the basic crops and applying improved soil-management practices, including irrigation, we have now reached an era of high yields on each acre of land.

Allotments are of great importance—and in some sections more valuable than the land itself.

Producing more and more on less land builds up surpluses which force the Government to enter certain marketing and administrative activities—a trend that farmers can expect until the population increases to the point where surpluses will be largely consumed. Though no one can tell what might happen in the future, high yields per acre of land are here to stay. Land not capable of producing high yields of field crops will probably be retired to pine trees.

Recent Trends in Crop Production

Farmers in many sections have gradually increased production goals for the last decade. The goals have been reached and even surpassed many times. A study of the yields produced by numerous farmers makes one wonder about the potential productive power of our Southern soils. A few years ago most of our farmers would have been satisfied with one bale of cotton, 1,000 lbs. of tobacco, or 50 bu. of corn on each acre planted to those crops. Now the same farmers are not satisfied with yields twice as high as the above ones.

Production contests, such as the "five-acre cotton and corn contests," have helped people realize the production possibilities of some soils. In these production contests, farmers took a few acres of the best land available for a particular crop and applied every soil management and production practice they could afford. Under these conditions, some extremely high yields were produced on each acre of land, giving the farmers and agricultural workers an opportunity to measure the yields and estimate the expenses involved. And deducting their total expenses from their gross income, they found the net income produced on each acre an encouraging figure in most cases where suitable land was selected. The importance of making use of all research information available was fully realized. From the few trial acres farmers learned that good soil management is a paying proposition.

"Shooting the works" on a few acres in order to find out how much could be produced set the stage for higher yields on several acres. After producing 2 and 3 bales of cotton, 200 bushels of corn, and 2,000-3,000 pounds

Fig. 2. Selecting suitable soil for the various crops is the first important step in producing high yields per unit of land. (Courtesy of Soil Conservation Service)

Fig. 3. Good soil management practices produced a high yield of corn in this field which was good corn land. This 4-H Club boy was happy with the results of his efforts. (Courtesy of Mississippi Extension Service)

of tobacco per acre, farmers were ready and willing to use good production practices on all acres planted to the major crops. This can be observed now on many farms. For example, in 1955 one Mississippi farm produced 2 bales of cotton per acre on over 700 acres. Another farm produced a little over 130 bushels of corn per acre on a hundred acres. High farm yields of the major crops, then, have encouraged better land selection for the cash crops, turning less productive land to pasture or forest. Timber, an important southern crop, will probably play a greater role in the future.

Steps in Producing High Yields

More production per acre has been the object of many people since the beginning of research work. In the beginning, it seems, the desire was to produce two blades of grass where only one had grown. This desire soon spread into other crops, with research workers beginning to produce twice as much grain, fruit, cotton, tobacco, and forage as had been produced on the same land before.

Producing high, efficient yields on each acre of land requires scientific information and technical practices. Some steps that help gain high yields are:

A. Use the Land Wisely
B. Prepare the Land Adequately (Subsoiling if Needed)
C. Use Fertilizer and Lime Liberally, Efficiently
D. Irrigate Where Feasible
E. Use the Best Varieties
F. Control Insects and Disease Pests.

Use the Land Wisely

It is hard to overemphasize soil-management practice. Good land use is the first step in getting high yields out of the various fields on a farm. The land selected in each case must be well suited for the crop produced on it. Otherwise the other production practices may not produce the desired or expected returns.

Prepare the Land Adequately

Field crops, generally, will not compete successfully with weeds and wild plants. For this reason, alone, land used for crop plants should receive good soil preparation. During this preparation, the soil is turned, loosened, stirred, and, at times, compacted. Many different methods get these results in different types of soil. But the preparation and subsequent tillage are usually done for two reasons: They are (1) to control weeds and (2) to prepare a suitable environment (seedbed) in which the crops can grow.

Subsoiling, also a part of land preparation, should be done when soils have plow soles that need to be shattered. This gives a soil more depth for root development and moisture storage. This is very important during dry years.

In addition, proper land preparation develops good physical properties in soils. The soil structure and the tilth are governed by the methods and operations used in preparing and tilling the soil. A soil in good physical condition is so well aerated that oxygen, needed by germinating seed and young plants, can easily enter it. Likewise, harmful gases can escape rapidly from such soil.

Good physical properties also enable a soil to absorb water readily in rainy periods, decreasing the runoff, building a reserve for dry periods, and reducing soil erosion. It should be said, however, that soil preparation should be adequate but not overdone. The number of operations needed varies with the type of soil used. Some farmers plow too much for the good of the soil and the crop.

Use Fertilizer & Lime Liberally, Efficiently

In producing high yields per acre, plant nutrients should be liberally applied to each field crop regardless of whether it is grown in rotation or continuously. Properly balanced plant nutrients should be applied at the proper time and in readily available forms. Since nature did not endow all Southern soils with high levels of natural fertility, plant nutrients have to be applied often for profitable yields. If any one of the plant nutrients becomes limited, research has shown, the yields of crops will be limited also. The modern trend toward higher yields

Fig. 4. The farmer planned for 100 bushels of corn. Less than 10 bushels were produced. One serious mistake was made. The soil or kind of land was not considered. This was not corn land. It should be put to some other use. (Courtesy of Dr. O. T. Osgood and the Mississippi Experiment Station)

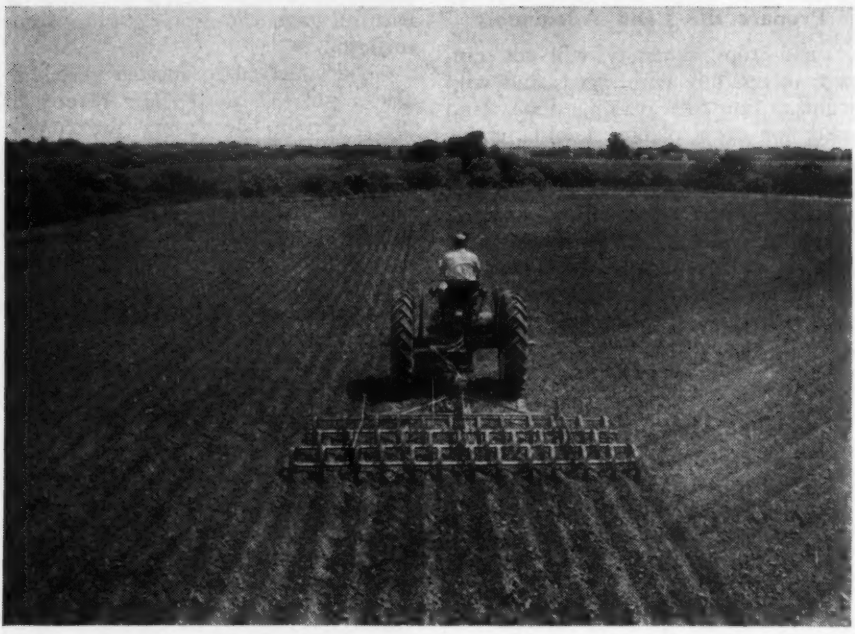


Fig. 5. Good soil preparation is another essential part of producing high yields on every acre of cropland. (Courtesy John Deer, Moline, Illinois)

per acre of land makes the matter of supplying needed plant nutrients a problem of great importance. Adequate plant nutrients can be provided field crops by using the following materials:

1. Organic matter
2. Commercial fertilizers
3. Lime.

1. *Organic matter.* Organic materials are important because they provide nitrogen for cultivated crops and add life to the soil. Nitrogen is the most expensive plant nutrient a farmer buys and one of the most deficient elements in Southern soils. Southern farmers, therefore, have to provide large quantities of nitrogen for the production of field crops.

The main kinds of organic matter used for supplying nitrogen to field crops are farm manure, green manure crops, and crop residues. The amounts of each of these sources used vary with the needs and conditions of individual farms. Those on which livestock are kept usually have large quantities of farm manure available. Farms without livestock must obtain nitrogen from other sources. In using farm manure on land which is used for field crop production, one should avoid getting the land infested with weed seeds.

Many of the green manure crops like vetch, crimson clover, burr clover, and small grain can be grown after the field crop is harvested and plowed under in the spring in time to produce another field crop. Growing green manure crops is an old practice in the South where the winters are mild. The amount of nitrogen that can be expected from a green manure crop varies with the plant and the growth made when it is plowed under. It has been estimated that under average conditions the nitrogen in a good green manure crop will produce yields of following field crops equivalent to yields obtained from 30-60 pounds of com-

Fig. 6. Well-fertilized cotton (plenty of N, P_2O_5 and K_2O) produced over 2 bales per acre on good cotton land when insects were controlled. (Courtesy of the Soil Conservation Service)

mercial nitrogen. If desirable, a farmer can use green manure crops for supplying only part of the nitrogen needed for field crops, since some farmers feel they can now buy nitrogen cheaper than they can grow it in green manure crops. Crops like corn, cotton, and some varieties of tobacco are responsive to green manure crops.

Crop residues, when properly handled, return plant nutrients to the soil. The materials are returned to the soil as dry stalks, leaves, straw, and other mature plant material. Since they are dry, the process of decomposition is quite slow. During the early stages of decay of such crop residues, little or no nitrogen will be released for growing crops. Therefore, when crop residues are used as a source of plant nutrients, they should be plowed under a long time before the main crop is planted. Sometimes it is necessary to apply additional nitrogen or manure in order to have nitrogen available for young plants and to get full benefits from the plant nutrients in crop residues.

2. *Commercial fertilizers.* Sufficient fertilizers should be applied to furnish all plant nutrients that are not furnished by organic materials and lime. The income from the field crops justifies liberal applications of complete fertilizers where needed. The correct grade or grades to use will depend on the soil and the crops. Every farmer should take advantage of soil tests and all other aids in choosing the proper grade needed for each major crop.

3. *Lime.* Field crop and pasture soils should be limed as often as needed in order to keep the soil reaction favorable for the growing crop and to provide calcium and magnesium for the soil and plants. The need for lime should be determined by soil tests and the crops grown. All soils should be tested regularly and lime applied as needed.

Soils have capacities to use fertilizers just as they have a capacity for holding moisture. All efforts should be made in a soil-management program to apply to each field the most efficient rates of lime and fertilizers. The following procedure will help determine the best rate of fertilization for a soil:

Fig. 7. The influence of nitrogen in corn production. Both plots were treated the same except for nitrogen. The plot in front received no nitrogen and produced 21.2 bushels of corn per acre. The plot in the background received 120# of N per acre and produced 100.4 bushels per acre. (Courtesy of Mississippi Agricultural Experiment Station)

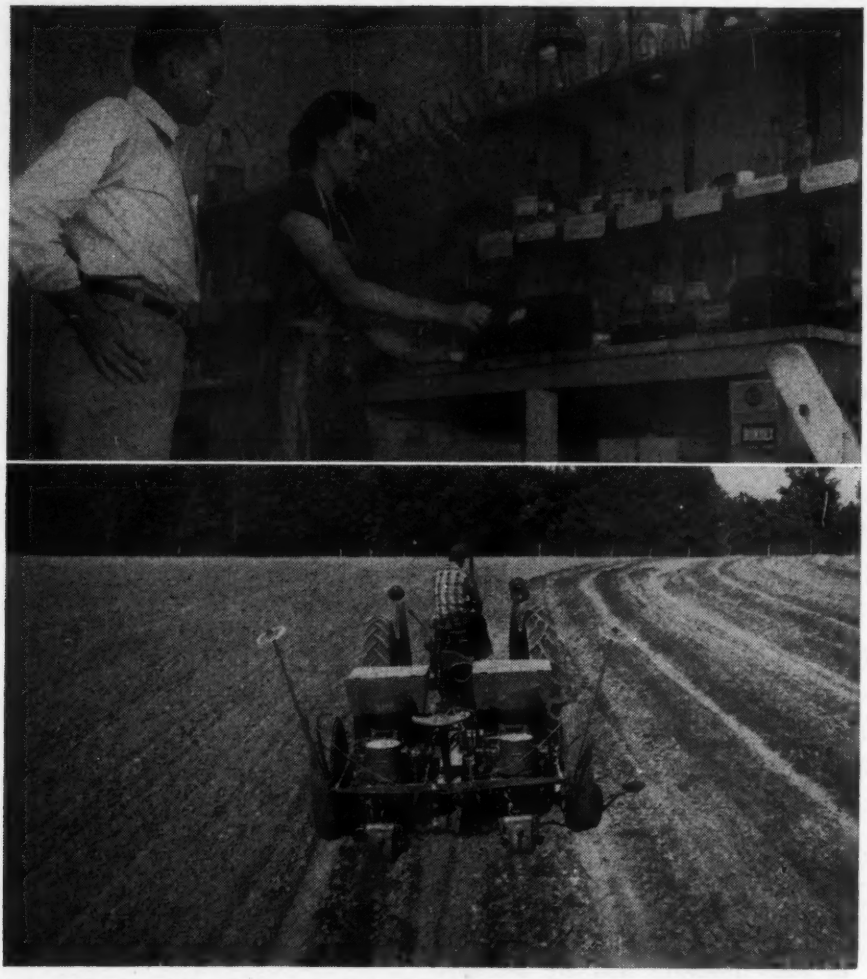


Fig. 8. Farmers should have their soils tested regularly and use the results for determining the most efficient grade and rate of fertilizer to use. (Courtesy Dr. George Smith, Mo. Agr. Exp. Sta.)

a. Consider the capacity of the soil to use plant nutrients

b. Have soil tests made

c. Consider the yields possible.

A factor that has never received too much attention in a fertility program is the possible or expected yields. It is perfectly clear, however, that soils with high capacities to produce will need and use more plant nutrients than soils with low capacities. It certainly takes more plant nutrients to produce 100 bushels of grain than it does to produce 50 bushels. Any thumb rule that can be used will point that out.

Irrigate Where Feasible

Irrigation, a soil-management practice now widely used over the South, should be considered by all farmers if they need it and if water can be obtained at a reasonable cost. This is a sure way to regulate soil moisture and insure high yields. Irrigation should be used on land that produces crops which have high cash values. By being

able to apply water as needed during the growing season, a farmer can use more fertilizer per acre—raising the level of production and the income from each acre of field crops.

Irrigation is a means of insurance for providing moisture for a crop when it is needed. Hence good profits are made from irrigation in dry years and little profit made in wet years or years of ample rainfall.

This is well illustrated by data from experiments conducted by the Georgia Experiment Station at Athens, Georgia. Yields of cotton over a five-year period are given in Table I.

It can be seen from the data in Table I that cotton, even a dry-weather crop, responds well to irrigation in dry years like 1952. In 1949 the rainfall during June, July, and August was about 12 inches and little response was obtained from irrigation.

The value of irrigation also depends on the crop that is grown. In 1953 several Southern experiment stations gave some estimates on increased crop values for irrigation, the additional cost per acre, and the net value per acre. It should be remembered that 1953 was a dry year. Some of these values and costs are given below.

In Georgia, in a corn experiment, irrigation produced $96 worth of corn. It cost $34 per acre which means a net value of $62 per acre for irrigation. The values for cotton were $109.85, $41.50, and $68.35, respectively. In a similar experiment using tomatoes, irrigation produced $165 worth of additional fruit and the cost was $31.50 per acre. This leaves a net increase for irrigation of $133.50 per acre.

In Virginia, irrigation of tobacco increased the value of crops $316 and cost $34. This leaves a net value of $282 per acre. Similar values for pasture used for milk production were $140.25, $44, and $96.25, respectively.

Supplemental irrigation for corn in Missouri the same year (1953) made a net increase of $32.10 per acre and $6.80 when applied to soybeans.

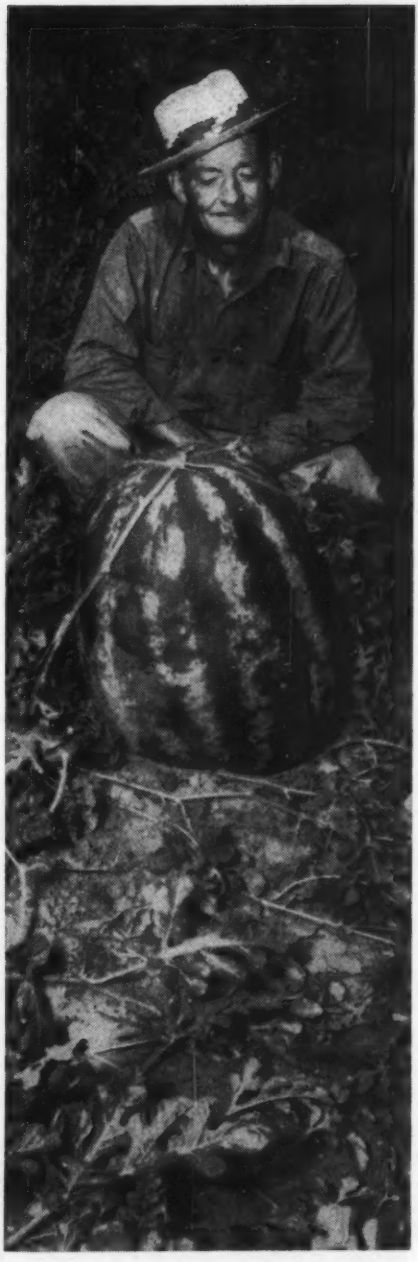


Fig. 9. Proper fertilization and good management produce results. It is hard to believe that a melon would grow that big. (Courtesy of the Mississippi Extension Service)

TABLE I.—RESPONSE OF COTTON TO IRRIGATION, ATHENS, GEORGIA.*

Year	Rainfall in June, July and August	Irrigation		Seed Cotton Yields	
				Unirrigated	Irrigated
	Inches	*Number*	*Inches*	*Pounds per acre*	*Pounds per acre*
1949	12.05	2	3.00	1,155	1,286
1950	9.93	1	1.50	1,087	1,430
1951	12.37	3	4.00	2,165	2,528
1952	8.82	7	9.44	742	2,534
1953	6.25	6	9.91	934	1,731

* Taken from 1955 U. S. D. A. Yearbook.

Irrigation, like other farming practices, will not solve all production problems alone. The greatest dividends will be gained when irrigation is used along with other good management practices. Good farmers will probably keep the irrigation equipment on hand and use it during dry years and store it during wet years. This would insure high yields each year of at least part of the cash crops and help to establish a well-balanced farming system.

When should water be added to growing crops? This is a difficult question to answer. Do not wait until

Fig. 10. High yields can be maintained during dry years by irrigation. The irrigated cotton on the left made over a bale per acre more than non-irrigated cotton on the right. (Courtesy of Mississippi Extension Service)

the plants wilt! This general rule will be helpful. Water should be applied to growing crops when the available soil moisture has been reduced to one half or 50% of the amount the soil will hold. For example, if a soil is capable of holding 16% available water, irrigation should be used when the moisture drops to about 8%. Plants wilt and die when all of the available water is used up.

Use the Best Varieties

Improved and better varieties are being developed continuously by state experiment stations and U. S. Department of Agriculture plant breeders. The advice of the nearest experiment station or official adviser should be sought before choosing a variety in order to have the best available. It would be impractical to apply enough fertilizer and water for maximum production and then plant a variety that would not yield as much as the best varieties available. That would be a sacrifice which would be expensive.

Control Insects and Disease Pests

Both insects and diseases are enemies of farm crops as well as mankind. A sudden attack can often result in a complete failure of a crop that otherwise would have given a good yield. The money and efforts used in controlling insects and diseases should be considered as good insurance. These enemies must be controlled in order for the other production practices to pay good dividends.

Good farmers always watch for signs of insects and diseases and try to keep both under good control. This problem may be more difficult on farms where irrigation is practiced. The fertilizer and the water may be total losses if diseases and insects are allowed to destroy or severely damage the crops to which they have been applied. It is not a question of whether one can afford to control these pests—one cannot afford not to control them in our new and improved agriculture.

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FRUIT TREES NEED PHOSPHORUS AND POTASH—TOO

APPLY a complete fertilizer to fruit trees every 3 or 4 years, Vernon Patterson, Ohio State University Extension Horticulturist, advises orchardmen.

Patterson says increasing evidence shows that trees need phosphorus and potash as well as nitrogen. Nitrogen is a growth regulator and trees need annual applications of ammonium nitrate, sulfate of ammonia, nitrate of soda, or other nitrogen carrier to get satisfactory growth and yields.

Growers may apply phosphorus, potash, and nitrogen in one application as a 10-10-10 or similar grade fertilizer on years that a complete fertilizer is used. Phosphorus and potash become available more slowly than nitrogen and require more time to reach the root zone of trees, so growers do not need to apply them as often as nitrogen.

Determine the amount of fertilizer to apply by the nitrogen needs of trees, Patterson suggests. He advises growers to use enough nitrogen to get 10 to 15 inches of shoot growth each year on bearing apple trees and 15 to 18 inches of annual shoot growth on peach trees.

A general guide for nitrogen applications is ¼ pound of a 16% nitrogen carrier for each year of age of bearing apple trees and ⅓ pound for each year of age of peach trees. Nitrogen needs vary with growth and appearance of trees and the cultural practices used in the orchard, however.

Some orchards need lime, too. No general recommendations are available for lime and so-called trace elements such as boron.

The Factories That Feed Us

By Edwin J. Benne

DEPARTMENT OF AGRICULTURAL CHEMISTRY • MICHIGAN STATE UNIVERSITY

DO you think of plants as being factories? They really are, and if it were not for their busy workers, the green leaves, there could be no life on earth. Energy is necessary for living, and only green plants can capture and store in a usable form the life-giving energy of sunlight. No animals, not even man, nor plants which are not green, are able to do this, yet all must have energy to live. Their immediate energy supply is food, and food can be manufactured only by green plants.

Plants store energy by a chemical process called photosynthesis. Photo refers to light, and synthesis means to build or put together. Photosynthesis then is a chemical reaction carried on in green plants which builds carbohydrates, like sugar and starch, from simple compounds obtained from the soil and air. Sunlight furnishes the energy to run the factories, and part of it is stored in the manufactured products.

The materials used in photosynthesis are remarkably simple. Water from the soil enters the roots of a plant and is carried to its green leaves. Carbon dioxide, a colorless gas in the air, which comes from the respiration of living things and from the burning and decay of organic materials, enters the leaves through little mouth-like openings called stomata. When carbon dioxide and water meet in a green leaf while the sun is shining on it, they unite to form carbohydrates and liberate oxygen to the air again. The term carbohydrate literally means a combination of carbon and water.

Since during the process oxygen is released from its union with carbon and set free again, chemists call photosynthesis a reduction reaction. Reduction reactions absorb energy which remains in the new substances formed, and it is in this way that the energy of sunlight is captured. The green coloring matter in the leaves is a complex chemical compound called chlorophyll. No one knows exactly the role it plays in forming food, but photosynthesis will not go on except in the presence of chlorophyll, which seems not to be changed during the process. A substance like this is called a catalyst.

Like any factory, a plant provides for bringing in raw materials and for storing finished products. A solid substance can move through a plant only if it is in solution in water. It is remarkable that in a single stem streams of water carry minerals from the roots to the leaves, while others moving in the opposite direction remove the products of photosynthesis from the leaves and carry them to where they are needed by hungry cells or to where they are to be stored. This movement of materials within a plant is called translocation.

Soluble sugars appear to be formed first in photosynthesis, but plants can change them to insoluble starch or cellulose for storage. They can also change carbohydrates to oils, and by the addition of nitrogen to proteins. These actions are reversible, and when necessary, oils and proteins can be changed back to carbohydrates. These latter changes can go on in the dark, and many of them occur at night to

clear the way for the new substances to be produced during the daylight hours of the following day.

Each of these compounds, however, contains the energy from the sun used to reduce the carbon within them. This excess energy is released when the carbon again combines with oxygen. Combination with oxygen is called oxidation, and respiration, decay, and burning are all oxidation reactions. When plant material burns, the stored energy is released as heat and light. It is released as heat during decay also, only more slowly. During respiration, although some of the energy in the food may be changed to heat, at least part of it is converted to physical energy and is used by the living cells for essential life processes. This is true for both animals and plants.

But whether the plant materials are oxidized during burning, decay, or respiration, the carbon within them is again changed to carbon dioxide and the hydrogen to water, the same substances used by plants in photosynthesis. The carbon dioxide passes into the air as gas and the water as vapor. The water vapor will finally condense and fall as rain to again enter plant roots, and the carbon dioxide will find its way into green leaves once more. There, while the sun is shining, they combine again into carbohydrates and capture a new portion of the sun's energy.

Besides storing energy, plants perform another important service for us. If it were not for the process of photosynthesis all of the oxygen of the air would have been used up long ago through burning, decay, and respiration. Each of these processes removes oxygen from the air and returns carbon dioxide to it, but photosynthesis removes this carbon dioxide from the air and returns oxygen. We must thank the green plants for keeping the air about us pure. They remove from the smoke of fires, from the exhaled breath of our bodies, and from the fumes of rotting plants and animals the carbon dioxide which stifles life, and they release the oxygen which living things must have.

Through the process of photosynthesis Nature has entrusted the feeding of the world to plants, which are above the greed and weaknesses of men. These silent workers do the job well. Without the noise and bustle so common in man-made factories, they carry on the work of storing up the sun's energy, not only for their own use, but more than enough for all the living things on earth. Great quantities of their excess products have been stored as forests, coal, petroleum, and natural gas, which contain the energy that makes possible the industrial civilization of today.

In the springtime the green leaves burst out enthusiastically to tackle their task anew. During the summer they whisper and murmur happily as they work so others may live, and for a brief time in autumn they are dressed in crimson and crowned with gold as a reward for a job well done.

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ABILITY TO PRODUCE ... UNMATCHED IN OUR HISTORY

"New knowledge based on research in using fertilizers and soils, in feeding, in breeding of plants and animals, and in controlling diseases and insects, has given farmers an ability to produce that is unmatched in our history. As a result, some 8½ million workers—one third fewer than 35 years ago—are producing bountifully on virtually the same amount of cropland for a population 55 per cent greater . . . and giving us the foods needed for better diets, too. In no other nation today do so few farmers produce so much food and fiber to feed and clothe so many at such a relatively cheap price."—*Byron T. Shaw, Administrator, Agricultural Research Service.*

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	28.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	45.9	128.0	214.0	124.0	188.0	16.50	43.40	....
1950.....	40.1	51.7	91.7	173.0	153.0	200.0	16.70	86.50	....
1951.....	37.9	51.1	163.0	304.0	166.0	211.0	19.50	69.30	....
1952.....	34.6	49.9	198.0	338.0	153.0	209.0	19.95	69.60	....
1953.....	32.3	52.2	78.1	244.0	148.0	204.0	17.45	52.60	....
1954.....	33.6	51.1	130.0	229.0	142 0	212.0	17.35	60.30	....
1955.....	32.3	53.1	94.2	177.0	131.0	198.0	17.65	44.60	....
1956									
January.....	30.67	51.3	99.4	199.0	116.0	195.0	16.55	45.50	....
February....	31.00	35.4	114.0	198.0	118.0	195.0	16.45	46.20	....
March.....	31.64	....	134.0	209.0	120.0	197.0	16.15	46.80	....
April.....	32.50	....	172.0	217.0	132.0	203.0	16.25	46.90	....
May.....	31.96	54.0	219.0	231.0	139.0	200.0	16.15	47.30	....
June.....	32.29	51.0	265.2	290.5	142.0	193.0	15.05	47.40	....
July.....	32.36	48.0	311.4	348.7	143.0	190.0	14.85	49.00	....
August.....	31.13	50.1	140.0	217.8	145.0	193.0	15.25	51.00	....
September...	32.50	53.4	100.0	191.0	143.0	195.0	15.95	47.60	....
October.....	31.94	53.0	80.4	194.0	119.0	198.0	16.75	54.10	....
November...	31.88	47.9	91.8	203.5	121.0	205.0	17.15	59.20	....
December...	30.99	61.0	91.2	241.0	122.0	207.0	17.95	59.90	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1930.....	77	128	131	123	93	76	93	98	128
1931.....	46	82	66	83	50	44	73	40	107
1932.....	52	105	55	62	50	43	52	46	100
1933.....	82	130	118	79	81	84	68	57	90
1934.....	100	213	64	91	127	96	111	146	94
1935.....	90	184	85	80	102	94	63	135	116
1936.....	100	236	164	106	163	116	94	148	108
1937.....	68	204	76	89	81	109	74	87	114
1938.....	69	196	80	79	76	64	57	97	96
1939.....	73	154	100	84	88	78	67	94	98
1940.....	80	160	78	97	96	77	64	96	122
1941.....	137	264	116	105	117	107	82	211	138
1942.....	153	369	168	134	143	124	91	202	178
1943.....	160	405	188	235	174	154	125	231	270
1944.....	167	420	214	216	170	160	139	234	236
1945.....	181	366	205	232	198	170	127	227	240
1946.....	263	382	178	248	212	209	141	319	217
1947.....	257	380	232	248	336	259	148	381	262
1948.....	245	482	222	253	201	226	155	298	253
1949.....	231	459	184	244	193	213	139	192	232
1950.....	323	517	132	197	238	226	141	384	211
1951.....	306	512	233	346	259	239	164	307	269
1952.....	279	499	284	385	238	236	168	309	274
1953.....	260	522	112	278	231	231	147	233	239
1954.....	270	511	187	261	221	240	146	267	223
1955.....	260	531	135	202	204	224	149	198	233
1956									
January.....	247	513	143	227	181	221	139	202	244
February....	250	354	164	226	184	221	139	205	244
March.....	255	...	192	238	187	223	136	208	214
April.....	262	...	247	247	206	230	137	208	202
May.....	258	540	314	263	217	226	136	210	239
June.....	260	510	389	331	221	218	127	210	345
July.....	261	480	455	397	223	215	125	217	351
August.....	251	501	201	248	226	218	128	226	230
September...	262	534	143	218	223	221	134	211	243
October.....	258	530	115	221	185	224	141	240	252
November...	257	479	132	232	188	232	145	263	274
December....	250	610	131	274	190	234	151	266	266

Wholesale Prices of Phosphates and Potash * *

	Superphosphate, Baltimore, per unit	Florida land, pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports [1]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports [1]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports [1]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports [1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950	.763	3.83	5.47	.371	.716	14.33	.195
1951	.813	3.98	5.47	.401	.780	15.25	.200
1952	.849	3.98	5.47	.401	.793	15.25	.200
1953	.878	....	....	.410	.793	15.25	.200
1954	.895	....	....	.405	.791	15.27	.200
1955	.895	....	....	.394	.771	14.79	.177
1956							
January	.895	....	....	.380	.735	14.00	.193
February	.895	....	....	.380	.735	14.00	.193
March	.895	....	....	.380	.735	14.00	.193
April	.895	....	....	.380	.735	14.00	.193
May	.895	....	....	.380	.735	14.00	.193
June	.895	....	....	.360	.720	13.45	.177
July	.895	....	....	.380	.735	14.00	.177
August	.895	....	....	.380	.735	14.00	.177
September	.895	....	....	.380	.735	14.00	.177
October	.895	....	....	.380	.735	14.00	.177
November	.895	....	....	.380	.735	14.00	.177
December	.895	....	....	.380	.735	14.00	.177
	Index Numbers (1910-14 = 100)						
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950	142	106	112	68	75	59	83
1951	152	110	112	72	82	63	83
1952	158	110	112	72	83	63	83
1953	164	...	...	73	83	63	83
1954	167	...	...	72	83	63	83
1955	167	...	...	70	81	61	82
1956							
January	167	...	...	69	77	58	82
February	167	...	...	69	77	58	82
March	167	...	...	69	77	58	82
April	167	...	...	69	77	58	82
May	167	...	...	69	77	58	82
June	167	...	...	66	76	56	80
July	167	...	...	69	77	58	80
August	167	...	...	69	77	58	80
September	167	...	...	69	77	58	80
October	167	...	...	69	77	58	80
November	167	...	...	69	77	58	80
December	167	...	...	69	77	58	80

Wholesale Prices of Ammoniates * *

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish, scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.85	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950	3.00	1.95	11.01	11.70	10.21	9.36
1951	3.16	1.97	13.20	10.92	10.18	10.09
1952	3.34	2.09	13.95	11.27	9.72	9.16
1953	3.26	2.27	11.04	11.19	7.39	7.09
1954	3.07	2.20	11.50	11.63	9.72	9.85
1955	2.98	2.11	9.97	12.01	6.96	6.91
1956						
January	2.98	2.12	9.43	12.75	5.58	5.58
February	2.98	2.12	8.69	12.15	5.77	5.69
March	2.98	2.12	8.30	11.89	5.92	5.92
April	2.98	2.12	8.31	11.66	5.77	5.71
May	2.98	1.70	8.67	11.80	6.60	6.37
June	2.98	1.56	8.72	11.29	6.37	6.23
July	2.98	1.56	9.37	10.89	6.80	6.37
August	2.98	1.56	9.99	11.26	6.53	6.37
September	2.98	1.56	9.10	11.28	6.68	6.68
October	2.90	1.56	9.11	11.35	7.53	6.86
November	2.88	1.56	9.41	11.58	6.07	6.37
December	2.88	1.56	9.47	11.80	6.61	6.07
Index Numbers (1910-14 = 100)						
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950	112	68	315	331	303	266
1951	118	69	377	310	302	287
1952	125	74	399	319	288	260
1953	122	80	315	317	219	201
1954	114	77	329	330	288	280
1955	111	74	285	340	207	196
1956						
January	111	74	269	361	166	159
February	111	74	248	344	171	162
March	111	74	237	337	176	168
April	111	74	237	330	171	162
May	111	60	248	334	196	181
June	111	55	249	320	189	177
July	111	55	268	308	202	181
August	111	55	285	319	194	181
September	111	55	260	320	198	190
October	108	55	260	322	223	195
November	107	55	269	328	180	181
December	107	55	271	334	196	172

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1930.....	125	140	126	105	72	131	101	99
1931.....	87	119	107	83	62	83	90	99
1932.....	65	102	95	71	46	48	85	99
1933.....	70	104	96	70	45	71	81	95
1934.....	90	118	109	72	47	90	91	72
1935.....	109	123	117	70	45	97	92	63
1936.....	114	123	118	73	47	107	89	69
1937.....	122	130	126	81	50	129	95	75
1938.....	97	122	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	124	130	127	86	56	130	120	77
1942.....	159	149	144	93	57	161	112	77
1943.....	193	165	151	94	57	160	117	77
1944.....	197	174	152	96	57	174	120	76
1945.....	207	180	154	97	57	175	121	76
1946.....	236	197	177	107	62	240	125	75
1947.....	276	231	222	130	74	362	139	72
1948.....	287	250	241	134	89	314	143	70
1949.....	250	240	226	137	99	319	144	70
1950.....	258	246	232	132	89	314	142	72
1951.....	302	271	258	139	93	331	152	76
1952.....	288	273	251	144	98	333	158	76
1953.....	258	262	247	139	100	269	164	77
1954.....	249	263	248	142	95	311	167	76
1955.....	237	262	249	134	92	255	167	74
1956								
January...	226	259	252	131	92	232	167	72
February..	226	259	252	130	92	225	167	72
March....	228	261	254	130	92	222	167	72
April.....	235	261	257	130	92	219	167	72
May.....	242	264	257	128	85	236	167	72
June.....	247	264	257	126	82	231	167	70
July.....	244	266	257	128	82	242	167	72
August....	237	267	259	128	82	246	167	72
September.	236	266	259	128	82	239	167	72
October...	234	265	259	128	81	252	167	72
November.	234	267	261	126	80	234	167	72
December..	237	267	261	127	80	244	167	72

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] Potash salts quoted F.O.B. mines; manure salts since June 1941; other carriers since June 1947.

** Where range of prices for fertilizer material is quoted, average figure is used. The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period.

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soil, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Arizona Eighteenth Annual Report, Commercial Fertilizers and Agricultural Minerals, Year Ending December 31, 1955," Agr. Exp. Sta., Univ. of Ariz., Mesa, Ariz., Spec. Bul., April 1956.

"Inspection of Commercial Fertilizers," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Insp. Rpt. 2, April 1956, F. W. Quackenbush and O. W. Ford.

"Distribution of Fertilizer Sales by Counties, Fertilizer Sales Classified by Ratios, Counties Grouped by Areas, for the Period January 1, 1956 Through June 30, 1956," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky.

"Minor Elements," Agr. Ext. Serv., Univ. of Ky., Lexington, Ky., Misc. 63, Sept. 1956, H. F. Massey.

"Handling Fertilizer in Bulk, a Study of Costs," Agr. Exp. Sta., Mich. State Univ., East Lansing, Mich., Spec. Bul. 408, June 1956, V. Sorenson and C. Hall.

"Charts and Maps Showing Fertilizer Consumption in Oklahoma, 1955-56," State Dept. of Agr., Oklahoma City, Okla.

"Inspection and Analysis of Commercial Fertilizers in South Carolina," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Bul. 441, Oct. 1956, B. D. Cloaninger.

"How Much Does My Nitrogen Cost?" Agr. Ext. Serv., Clemson Agr. College, Clemson, S. C., Inf. Card 83, Oct. 1956, H. A. Woodle, G. H. Collings, H. P. Cooper, and W. R. Paden.

"Analyses of Commercial Fertilizers Sold During 1955-56," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Bul. 841. Oct. 1956, J. F. Fudge.

"Wisconsin Fertilizer Statistics, 1955-56," State Dept. of Agr., Madison, Wis., No. 337, Dec. 1956, W. B. Griem.

"Fertilizers Applied in Liquid Forms," USDA, Wash., D. C., ARS 22-35, Nov. 1956.

Soils

"Irrigation of Sweet Potatoes, Snap Beans, and Cucumbers in Arkansas," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 578, June 1956, J. L. Bowers, R. H. Benedict, and J. McFerran.

"Lawrence County Soils," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Soil Rpt. 78, April 1956, J. B. Fehrenbacher and R. T. Odell.

"The Role of Small Watershed Programs in Soil Conservation and Water Management," Agr. Ext. Serv., Iowa State College, Ames, Iowa, Pamph. 231, July 1956, L. E. Clapp and F. W. Schaller.

"Culture and Agricultural Importance of Earthworms," Agr. Exp. Sta., Mich. State Univ., East Lansing, Mich., Cir. Bul. 222, July 1956, R. C. Ball and L. L. Curry.

"Soils and Methods Used in Irrigation Experiments at Geneva, New York," Agr. Exp. Sta., Cornell Univ., Geneva, N. Y., Bul. 775, March 1956, M. T. Vittum and N. H. Peck.

"Building Fertility in Exposed Subsoil," Agr. Exp. Sta., Wooster, Ohio, Res. Bul. 782, Oct. 1956, M. A. Bachtell, C. J. Willard, and G. S. Taylor.

"Grass Seed Production Under Irrigation in Oklahoma," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Bul. B-481, Oct. 1956, J. Harlan, R. M. Ahring, and W. R. Kneebone.

"Guides in Cotton Irrigation on the High Plains," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Bul. 838, Sept. 1956, E. L. Thaxton, Jr. and N. P. Swanson.

"Soil Survey, Cherry County, Nebraska," USDA, Wash., D. C., Series 1940, No. 21.

"Soil Survey, Livingston County, New York," USDA, Wash., D. C., Series 1941, No. 15.

"Soil Survey, Noble County, Oklahoma," USDA, Wash., D. C., Series 1941, No. 16.

"Soil Survey, Johnson County, Tennessee," USDA, Wash., D. C., Series 1946, No. 2.

"Soil Survey, Sevier County, Tennessee," USDA, Wash., D. C., Series 1945, No. 1.

"Soil Survey, Fauquier County, Virginia," USDA, Wash., D. C., Series 1944, No. 7.

Crops

"64th and 65th Annual Reports, January 1, 1953-December 31, 1954," Agr. Exp. Sta., Ala. Polytechnic Institute, Auburn, Ala.

"Fruits for Alaska," Agr. Exp. Sta., Univ. of Alaska, Palmer, Alaska, Ext. Cir. 420, April 1956.

"Pecans in Arizona," Agr. Ext. Serv., Univ. of Ariz., Tucson, Ariz., Cir. 247, Sept. 1956, H. F. Tate and L. W. Whitworth.

"Effects of Cutting Systems on Ladino Clover," Agr. Exp. Sta., Univ. of Conn., Storrs, Conn., Bul. 313, Jan. 1956, B. A. Brown and R. I. Munsell.

"Studies of Mineral Balance as Related to Occurrence of Baldwin Spot in Connecticut," Agr. Exp. Sta., New Haven, Conn., Bul. 601, Oct. 1956, P. Garman and W. T. Mathis.

"Annual Report of the State Board of Agriculture, 1955-1956," State Dept. of Agr., Dover, Del., Vol. 46, No. 3, J. L. Clough.

"The Story of Florida Citrus," State Dept. of Agr., Tallahassee, Fla., Bul. 177, Aug. 1956.

"Small Grains in Georgia," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Cir. 314, Rev. Aug. 1956, J. R. Johnson, W. H. Gurley, and J. F. McGill.

"19th Biennial Report of the Department of Agriculture for July 1, 1954-June 30, 1956," State Dept. of Agr., Boise, Idaho.

"Spring Oats for Illinois," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., No. 31, Nov. 1956.

"Raspberry Culture in Kentucky," Agr. Ext. Serv., Univ. of Ky., Lexington, Ky., Cir. 471, May 1956, C. S. Waltman.

"The Lawn," Agr. Ext. Serv., Univ. of Ky., Lexington, Ky., Lflt. 172, Aug. 1956, N. R. Elliott.

"Winter Pasture Studies in Southwest Louisiana," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., Bul. 509, June 1956, D. E. Black and R. K. Walker.

"1956 Nebraska Spring Small Grain Variety Tests," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Outstate Testing Cir. 55, Sept. 1956, A. F. Dreier, J. W. Schmidt, and P. L. Ehlers.

Economics

"Growth and Financial Condition of 13 Farmers' Cooperatives in North Georgia, 1944-1954," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Mimeo. Series N. S. 25, Sept. 1956, N. M. Penny.

"Harvesting Efficiency of Small Grains and Seeds," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Bul. N. S. 19, March 1956, O. Steanson.

"Production Function, Isoquants, Isoclines and Economic Optima in Corn Fertilization for Experiments with Two and Three Variable Nutrients," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Res. Bul. 441, Aug. 1956, W. G. Brown, E. O. Heady, J. T. Pesek, and J. A. Stritzel.

"What You Should Know About Marketing," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., YMW Cir. 5, Sept. 1956, H. C. Pederson and F. L. Olson.

"Migrant Agricultural Labor in Ohio," Agr. Exp. Sta., Wooster, Ohio, Res. Bul. 780, Sept. 1956, W. H. Andrews and S. Z. Nagi.

"Marketing Grain Through Ohio Terminal Facilities," Agr. Exp. Sta., Wooster, Ohio, Res. Cir. 38, Oct. 1956, J. W. Sharp and C. E. Fuller.

"Legislation Affecting the Rice Industry, 1933-56," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Bul. 839, Oct. 1956, J. A. Kincannon.

"Production Expenses of Farm Operators, by States, 1949-55," USDA, Wash., D. C., AMS-85, Oct. 1956.

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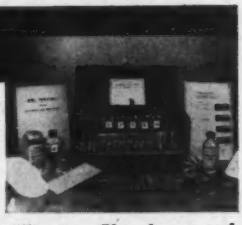

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II-12-51 Pasture Improvement With 10-10-10 Fertilizer
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K-3-53 Kudzu Keeps Growing During Droughts
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P-4-53 Learning How to Make Profits from Sweet Potatoes
T-5-53 Trefoil Is Different
DD-10-53 Sampling Soils for Chemical Tests
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JJ-11-53 Boron—Important to Crops
MM-12-53 White Birch Helps Restore Potash-Deficient Forest Soils
K-2-54 Soil and Plant Analyses Increase Fertilizer Efficiency
R-3-54 Soil Fertility (Basis for High Crop Production)
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EE-8-54 Red Apples Require Balanced Nutrition
FF-8-54 Apply Fertilizers in Fall For Old Alfalfa, Grass Pasture and Timothy-Brome Fields
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LL-10-54 Relation of Fertilizer to Quality and Yield of Flue-cured Tobacco
MM-10-54 Longer Life for Ladino
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C-1-55 Summary of Ten Years' Work with Complete Fertilizers on Sugar Cane
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A Lancashire woman, wishing to lose weight, had been put on a diet by her doctor. One day a friend dropped in and was amazed to behold her tackling with great appetite a large potato-pie.

"I thought you were on a diet!" exclaimed the visitor.

"Aye, so I am," was the reply. "But I've had me diet, and now I'm havin' me dinner."

• • •

Judge—"You've stolen no chickens?"
Mose—"No sah, Judge."
Judge—"And no turkeys?"
Mose—"No sah."
Judge—"Or geese?"
Mose—"No sah."
Judge—"Case dismissed."
Mose—"Ah sho' is glad you all didn't say ducks, Judge."

• • •

Came the day of their 25th wedding anniversary and the man of the house started out to do his work in the fields as usual. "John," his wife called. "Don't you know what day this is?"

"Yes, indeed I do," said John smoothly.

"Well, how are we going to celebrate it?" persisted his wife.

"Sure and I don't know, Maggie," said John, scratching his head in puzzlement. "How about two minutes of silence?"

"Our baby has started reciting nursery rhymes. Today he chose 'Baa baa, black sheep, have you any wool?' "

"At eight months! Incredible!"

"Well, he didn't say quite all of it. But the 'baa' was as plain as day."

• • •

A Scotsman bought a nickel's worth of peppermint drops and took his bride for a honeymoon ride on a street car. When they got off the car, he said, "Honey, suppose we save the rest of the candy for the children."

• • •

Checking some questionnaires that had just been filled in, a census clerk was amazed to note on one the figures 121 and 125 in the spaces for "Age of Mother, if living," and "Age of Father, if living."

"Surely your parents can't be as old as this?" asked the incredulous clerk.

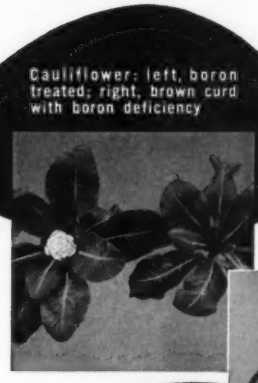
"Well, no," was the answer, "but they would be—if living."

• • •

Multiply your age by 2 and add 5 to the result. Then multiply by 50. Add the change in your pocket if less than a dollar.

Subtract the number of days in the year, 365. Then add 115 for good measure.

The two left-hand figures will show your age, and the two right-hand figures, the change in your pocket.



Cauliflower: left, boron treated; right, brown curd with boron deficiency

Alfalfa yellows and rosetting due to boron deficiency

Apples with external cork cracks, necrotic areas and dwarfed

Tobacco with die-back of terminal bud rolling of upper leaves

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